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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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The University Man in Business.

From time to time the question of the University man in business puts in an appearance in the daily press, and invariably the same two points of view are expressed. On the one hand, the disillusioned business man complains that such and such a percentage of University graduates are failures in the business world; and, on the other hand, a graduate, usually young, objects that University men would make a brilliant success of business life if they were only given a fair chance to do so.

The whole argument arises from a misconception. It is moreover a misconception that exists in an even more extreme form in other quarters, as witness the reported words of a noted film actor recently in this country. He is said to have expressed surprise that there has been no attempt on this side of the Atlantic to copy the American example and establish university courses in film work—scenario writing, film acting, and motion picture direction. Now this to the Englishman seems slightly comic, although he might find it difficult to say exactly why. University education in this country, as elsewhere in the old world, is directly descended from the mediæval university, whose name derives from the fact that its studies were general or universal. This is more or less apparent both in the case of the older foundations and in the more directly practical universities in our industrial centres, and the idea of a degree in film work is more than a little incongruous.

For in this country we do still preserve in our educational system some distinction between education and training. The ordinary schools and universities offer education—for life. The training schools and technical colleges offer training—for a job. Ideally everyone should have both; actually many have neither. But the two remain distinct and separate.

It follows from this that a university education *per se* cannot fit a man for business: if the man has personality and "push" it will no doubt increase his value, but if he be weak and diffident it cannot help him at all. The university man, however much he may be inclined to think of himself in some such way, is not a peculiar species of creature; he is only an ordinary man who has had exceptional educational advantages, and does not always make the fullest use of them. Nor again is he necessarily entitled by the mere reason of his university education, to demand a specially high rate of pay and special conditions in any job whatsoever, as some very young graduates are a little inclined to expect.

Business training, however—or rather, training for business—is a very different matter. It is this that the smaller American universities and colleges offer in the guise of a degree course, and that it fits into their university system comfortably is no proof that it would do the same here. Surely we are more likely to make progress in training the efficient business man that we need by the establishment of specific institutions and courses for the purpose than by any attempt to graft such courses on to our university system as it exists to-day.

Reporting Progress.

It takes quite a while, even under modern conditions of communication, to get a reply from Australia and New Zealand, whilst the remote parts of Africa, India and Canada, too, are not always easily accessible for the rapid exchange of letters. Thus do we deem it desirable even at this early date to call attention to the great effort which is being made by the British foundry and allied industries to stage during June next year an international conference and exhibition destined to show the world just what progress the foundry has made. Foreign readers will excuse, we are sure, the introduction of a little patriotism in what is primarily an international demonstration, but we do feel that without strong delegations from the British Dominions and Colonies, the manifestation would be incomplete.

We would first appeal to these far-away readers to come to Britain next year on business grounds, because there will be collected under one roof exhibits of foundry plant, processes and produce of the latest type emanating from every industrial country. Thus much arduous and possibly unremunerate travelling can be eliminated with the reasonable assurance that they are missing nothing of importance. A further appeal is made on the ground of the international aspect of the gathering. They no doubt have studied applicable sections of the researches of the leaders of thought in the world's foundry industry. Whilst we cannot guarantee the presence in London next year of all of the foundry savants, we are already assured that the gathering will be definitely representative.

A third reason for making this trip is that the production and methods of the "out-post" foundries may be, and probably are, more closely inter-related, than to ours in the heart of the Empire. In the effort being made next year opportunity will be afforded for mutual discussion of these by men who have "gone through the mill" in the various corners of the earth.

A final suggestion is that these far away founders will contribute their quota to the technical exhibit by sending or bringing typical examples of their wasters and successes. The home founders are taking up this section of the exhibition enthusiastically, and Mr. Wesley Lambert, the president-elect of the Institute of British Foundrymen, has already received many promises of support. Founders who have castings of historic non-commercial artistic or technical interest should communicate with Mr. Lambert, care of Messrs. J. Stone & Company, Limited, Deptford, London, S.E.

It is of interest to note that the German Foundry Employers' Federation have postponed holding their foundry exhibition scheduled for next year until the autumn in order that they may concentrate on making the London International Exhibition a hundred per cent. success

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Aluminium Casting Alloys.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We have read Capt. Mortimer's excellent review on commercial aluminium alloys, which he gave as a paper under the above title to the Leicester meeting of the Institute of British Foundrymen, and which you recently published in your columns.

We were interested in the paper as a whole, but particularly in Capt. Mortimer's remarks with regard to the modified aluminium-silicon alloys, for as pioneer manufacturers, owners, and controllers of the patent processes for this class of alloy, we find ourselves in complete agreement

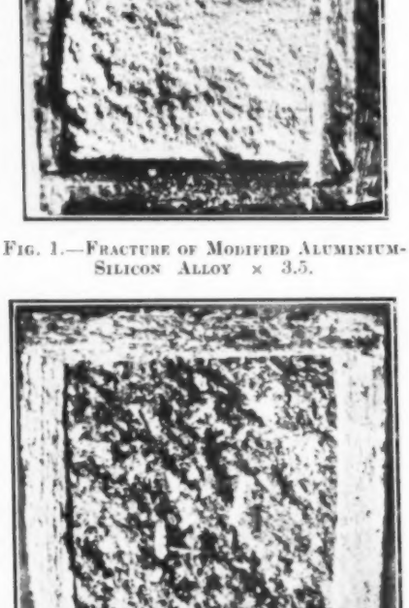


FIG. 1.—FRACTURE OF MODIFIED ALUMINIUM-SILICON ALLOY × 3.5.

FIG. 2.—FRACTURE OF UNMODIFIED ALUMINIUM-SILICON ALLOY × 3.5.

with what Capt. Mortimer has said as to the uselessness and positive danger of relying upon the result obtained from the standard chill cast test bar when used as representing the quality of the actual casting or castings.

The plain fact of the matter is that the mechanical modification obtained by casting in a chill mould is often sufficient to produce acceptance results in a bar so cast. The approximate results to be obtained from chill test bars and sand castings in modified and unmodified aluminium-silicon alloy can be compared from the table below.

	M.S. tons sq. in.	E. per cent. in 2 ins.
Unmodified chill test bar ...	12-13	about 8
Unmodified sand casting ...	about 7	up to 3
Modified chill test bar ...	13-16	10-20
Modified sand casting ...	11-13	7-15

It will be noted that the difference in strength between the unmodified sand casting and the chill test bar representing it is far greater than the difference between the modified sand casting and the modified chill bar. The erroneous impression obtained by accepting the result of the chill cast bar could be completely corrected by means of a check test piece cast on each sand casting for the authorised inspector himself to break off. The structure of the fracture of such a coupon shows clearly at a glance whether in fact the essential modification has been carried out, and enables a very fair estimate to be made of the properties to be anticipated.

The structure of the fracture of a properly modified sand casting is fine and silky, as in Fig. 1, which shows such a coupon broken from a modified sand casting. Fig. 2 shows the fracture of a coupon broken from an unmodified casting. It will be seen that in this case the structure is very coarsely crystalline.

Our reason for writing you at this length is that we feel that with the growing use of this class of alloy for parts of vehicles for air, road and rail transport, the serious attention of designers and engineers using these alloys should be drawn to the possible risk of life and limb incurred by the use of castings of doubtful strength produced by inexperienced persons who are misguided by chill test bar results, and we trust that for this reason you will be able to find space in your valuable Journal to publish this letter and photographs.—Yours, etc.,

W. H. GRIEVE, General Manager.
LIGHTALLOYS, LIMITED.
Alpax Works, St. Leonards Road,
Willesden Junction, London, N.W.10.
July 18, 1928.

Nickel-Bearing Pig-Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We notice a letter in your last issue under the heading "Nickel-Bearing Pig-Iron." Your readers may be interested to know that at least one brand of British refined pig-iron is available with a nickel content. It is, therefore, unnecessary for the British foundry trade to go abroad if they require pig-iron of this description.—Yours, etc.,

FOR BRADLEY & FOSTER, LIMITED,
G. T. LUNT, Director.

Darlaston.
July 23, 1928.

New Companies.

Barker Bros. (Brassfounders), Limited, Mount Works, Tower Street, Birmingham.—Capital £8,000.

Associated Electrical Industries, Limited.—Capital £100,000 in £1 shares (50,000 7 per cent. cumulative preference, with priority as to capital). Solicitors: A. R. Monks, Crown House, Aldwych, London, W.C.2.

Endurance of Rail Steel.—The U.S. Bureau of Standards has just published the results of a co-operative investigation with the Manufacturers' Rail Steel Committee, and the Joint Committee on Stresses in Track of the American Railway Engineering Association and the American Society of Civil Engineers in the study of rail failures, with particular reference to transverse-fissure failures. These failures in rails are known to be progressive—or fatigue—failures, developing under repeated track stresses and starting from definite nuclei, the origin of which is not yet known. A knowledge of the endurance properties of rail steels, it was believed, should throw some light on this problem. The quantitative endurance properties of rail steel before and after service have not heretofore been determined. Specimens from new 100-lb. rails made by standard methods and also from rails rolled from sink-head ingots have been tested in the usual rotary beam fatigue test. Specimens cut from the head of 100-lb. rails which passed the specification requirements of the American Railway Engineering Association gave endurance limits from about 41,000 to 59,000 lbs. per sq. in. "Over-stressing" was found to reduce the endurance limit and "under-stressing" to raise it. An endurance limit of 65,000 lbs. per sq. in. was obtained by "under-stressing." The rail steels from sink-head ingots showed in general greater fatigue strength than specimens cut from the rails rolled from standard ingots. It should be emphasised that the values for endurance limits given are for the steel in the rail only, and do not necessarily apply to the rail in the track. A greater knowledge of the stresses in the track must be known before these laboratory tests and service data can be correlated.—"The Iron Age."

Random Shots.

It is the easiest thing in the world to glance at a collection of figures, or even to read them through carefully, and yet fail to extract from them the essential information that they contain. Here is a case in point. The general secretary of the National Union of Blastfurnacemen gave a number of interesting figures concerning the production of pig-iron at Blackpool recently. Before the war and up to 1920 the industry employed 30,000 workpeople, operated 330 blast furnaces, and produced about 9,500,000 tons of pig-iron. To-day the figures are: Workers, 18,000; furnaces, 146; and production, 7,000,000 tons. Now the casual glance merely reveals that all the figures have dropped considerably, the number of furnaces in blast most of all, and the conclusion is not a very cheerful one. But think again. Although there has certainly been a drop in production, that drop is infinitely less in proportion than the drop in furnaces and workers—in other words, the output per furnace has increased over the period in question by 45 per cent. It becomes for the moment a somewhat secondary consideration how far the industry can hope to regain its former proportions, in view of the highly satisfactory increase in efficiency and intensity of production that the figures represent.

* * *

My reference last week to the "Aslib" Directory reminds me that the Association is holding its fifth annual conference at Oxford in September. It has already met twice in Oxford and once in Cambridge, in addition, I understand, to its inaugural meeting at a "conference house" in Herts. Its conferences are of great interest, for they attract people from all spheres of activity who share an interest in the collection and dissemination of specialised information. In addition, these meetings are of peculiar importance to the Association itself, since it is practically an organisation from Conference to Conference, holding no meetings and making no serious demands upon its members between whiles.

* * *

Quite an astonishing degree of interest seems to have been taken by the general public in the recent opening of the Penpoll tin smelter. One expects, after all, to see adequate space given to such proceedings in the technical Press and adequate interest taken in them by technical men, but the great mass that reads the illustrated dailies is quite another story. The reason probably lies in the lavish use of the superlative—not without justification, of course—in the descriptions of the smelter. We were told that it was "the biggest and most up-to-date British-owned—in Europe"—that its tin-ore stores are the "largest in the world"—that the reduction methods are "the latest"—and so on. The public may have but the vaguest ideas on the subject of tin ore and the process of tin smelting, but anyone can understand superlatives!

* * *

How much brighter life in the foundry world would be if we talked to-day in the language of Shakespeare, as, for instance, the following conversation between two moulders:—

First Moulder: Goest thou to-night to yonder closure green
To watch the frolics of the canine race?
Second Moulder: Indeed I do, and my good dame as well,
And each will toss a cap at Fortune's wheel
'Ere we return. . . .
First Moulder: Good luck attend you, friend.

* * *

A strong, hefty fellow applied at the foundry for a job, and was told he could have a try. A few days later he came to beg a job for his brother. "'E's jest as strong an' 'earty as me," he assured the foreman, and was accordingly told to bring the brother along. Next week he came again, this time on his father's behalf. "Don't let 'is age tell against 'im," he pleaded, "'e's as strong an' hactive as ever 'e were, an' 'e works as 'ard as me an' me brother put together." "Right," said the foreman. "He can start in the morning. You an' your brother are fired!"

MARKSMAN

Problems in Aluminium Founding.*

Dfficulties in Manufacture Solved.

The discussion on Capt. Mortimer's Paper took place at the Non-Ferrous Section, which was taken in the Lounge of the Y.M.C.A. Hall, under the chairmanship of MR. WESLEY LAMBERT. Owing, however, to the great interest taken in the Paper, the discussion was adjourned to the Hall, where the main body of the Conference was sitting.

MR. H. MILNER asked Capt. Mortimer if he had made any tests on aluminium alloys with the object of eliminating "draw," particularly when making such castings as aluminium cast pattern-plates. The pattern-plates the speaker used were 20 to 30 in. square, and had to be cast so clean that they only would require brushing with a wire brush before being put into commission.

The speaker pointed out that he had tried various analyses of aluminium and copper; aluminium, copper and zinc; and aluminium, copper and silicon, for pattern-plates, but had not been able to eradicate traces of "draw," which usually took place in proximity to heavy risers. Finally, he asked Capt. Mortimer if he had had any experience of an alloy suitable for this class of work.

MR. H. C. DEWS, after expressing his gratification at the long overdue interest, as evidenced in the present session, which was being shown by the Institute in non-ferrous foundry work, asked the author for further amplification of the excellent account of gases in aluminium which he had given in his Paper. Was Capt. Mortimer quite sure that the list of gases he had given were soluble in aluminium, or were they combined with the aluminium? On that depended what explanation one accepted of the effect of the nitrogen treatment. The suggestion that the partial pressure due to the insoluble nitrogen released hydrogen from solution was so simple and plausible that it should be considered very carefully. Metallurgical research had provided ample examples of the inadvisability of too readily accepting an orthodox chemical or physical explanation of things. The speaker did not wish to controvert this simple explanation, but merely to utter a word of caution and to press for Capt. Mortimer's views on the matter. With regard to the commercial application of nitrogen treatment, it appeared that ordinary nitrogen in cylinders would be used, and it was not generally known how impure this nitrogen might be. It contained appreciable amounts of oxygen and other gases, and it was worth asking what effect these impurities had on the aluminium. Finally, there was to be considered the commercial side of the process which so far had been sponsored almost entirely by academic workers, and the speaker would be very glad if the author, with his valuable industrial experience, could give them a lead on the commercial aspect of this treatment.

MR. G. BUCHANAN inquired as to the best method of recovering the metal lost in the skimmings when melting aluminium.

Archbutt Nitrogen Process.

MR. LOGAN (Newcastle) regretted that he had not thoroughly read and digested the Paper, but from what he had seen of it, it appeared to be a very comprehensive Paper on aluminium founding, and, no doubt, would be very valuable for future reference. There were only one or two questions which he would like to ask the author. The Archbutt nitrogen process was mentioned as being a method used to eliminate the trouble known as "speckled metal." Was this a practical commercial proposition, because if so, could it not be used in other branches of non-ferrous founding, as, for instance the casting of pure copper alloys?

Then he would like to ask the author if he had any particular pet theories of his own with regard to the "modification" of aluminium alloys. He also noticed that mention was made in the Paper of "Perlit" cast-iron pots for aluminium melting. What was the author's experience with regard to these compared with an ordinary cast-iron pot?

MR. T. W. MARKLAND (Bolton) asked whether the author could state the cause of aluminium seeming to be very sluggish, which property became intensified as the casting temperature rose; moreover, after casting, the heads appeared to be more liquid at a lower temperature. He desired to know the casting temperature for running castings of $\frac{1}{8}$-in. section and $\frac{3}{8}$-in. section respectively.

MAJOR ATHEY asked if in the series of tests which were made relating to L.8 alloy, it was found that if the silicon content be increased to more than 1 per cent. there was a big decrease in the tensile strength. For example, in one case where the silicon content was 1.46 per cent., the tensile strength dropped to 8 tons. Was the decrease in tensile strength entirely due to the increase in the silicon content. Was there a definite ratio between silicon content in L.8 alloy, and the tensile strength?

CAPT. GEORGE MORTIMER.

Capt. George Mortimer, the author of the Paper on "Aluminium Casting Alloys," is managing director of Messrs. Wm. Mills, Limited, of Birmingham, the well-known aluminium foundry.

Difficulties with an Alloy for Cylinder Pistons.

MR. J. J. MCCLELLAND said that during the war he was asked to make a die mould for producing air-craft cylinder pistons. A sample casting was supplied to make the mould to, and as it was an easy matter to follow the way the mould had been made for the sample casting, by following the joint lines, he made the mould exactly the same way. The metal to be used in the mould had to be alloyed to a Government standard or formula, and when they tried to pour it into the mould the metal was not fluid enough to run a complete casting although the mould was heated and everything done to assist it.

This failure resulted in an action at law in which both sides employed an analyst, because the maker of the mould contended that he was not responsible for the composition of the metal, and the other side contended the metal was the same as the sample casting that was supplied for working to. Each of the analysts took a part of the casting and after analysing they gave contrary opinions concerning the alloy.

The practical men connected with the case contended that, as the sample casting had gone very dark, almost black, while the new alloy retained a perfect whiteness the two alloys could not be exactly the same. Thus, the case ended very unsatisfactorily for both sides. His point was, as a practical man and not a metallurgist, that it appeared to be possible for analysts to have very widely differing opinions.

MR. E. J. L. HOWARD asked whether Capt. Mortimer had any data of the relative rate of wear of the various aluminium alloys, *i.e.*, the rate of wear on an aluminium alloy moving over a brass or aluminium surface. Would the wear be less than that which took place on a bronze? What were the comparative impact figures, as measured by the Stanton repeated impact test, of the aluminium-copper and aluminium-silicon alloys? Which of the aluminium alloys was the most suitable for resistance to general corrosion and particularly to very dilute caustic soda solution—about 0.05 per cent. caustic soda?

Disintegration of Ingot made from Aluminium Swarf.

DR. BUDGEN said it had been mentioned that when melting some aluminium swarf, an ingot which disintegrated after exposure to the atmosphere had been obtained. The material might possibly have been zinc-base aluminium-alloy or had become mixed with some other elements, such as zinc and tin.

No ordinary aluminium-alloy with aluminium predominating was in the least degree liable to disintegration of the kind mentioned, but alloys composed mainly of zinc with a little aluminium, as used for zinc-base die-castings and sometimes erroneously called aluminium-alloys, were under some circumstances liable to disintegration.

With regard to the best method of treating aluminium swarf, it was a matter of prime importance first to see that the material was as clean as it was possible to make it by riddling to remove fine dust, and centrifuging to remove the cutting compound or paraffin used in machining. A small proportion of dirt much reduced the metallic extractions on melting.

For large quantities, melting was quite well accomplished in cast-iron pots, provided they were first coated inside with a wash of whiting mixed with a little silicate of soda to assist adhesion. Salamander crucibles were equally satisfactory for small heats.

The melting pot should be about one-third filled with molten aluminium at about 650 deg. C., into which the fines were rabbled with a cast-iron rabble. The metal should be maintained in a pasty condition, the temperature not being allowed to rise at all high. More and more material was rabbled in until the pot was full of pasty or semi-melted metal.

The crucible was then covered with a tightly fitting lid and the aluminium paste heated up a little, fluxed with about 1 per cent. of zinc chloride, and the dry dusty oxide skimmed from the surface. The metal should then be ingotted and analysed. Care must be taken throughout not to soften the material more than was necessary, to agglomerate the entire mass so that oxidation of the small particles of aluminium was largely avoided. Clean dry aluminium alloy chips and turnings would yield from 80 to 88 per cent. of ingot if treated in this way.

Aluminium Pattern-Plates

MR. TYSON said that one gentleman asked what was the best alloy to use for aluminium pattern-plates. He took it he meant aluminium plates only. They made a large number of pattern plates in white metal, but, when using aluminium, the best metal they had found was the silicon alloy, containing 8 to 9 per cent. Si. It was possible then, if they had any breakdown with the pattern at any time, to repair it so much easier with that metal than with another alloy, either by burning a piece on the broken part or by welding. With a silicon alloy it was necessary, where one had heavy sections, to put large feeders over those particular parts. It all depended on what these pattern plates were for, whether they were large or small. The L8 mixture for a very small pattern was quite good. The shrinkage, as explained in Capt. Mortimer's Paper, for a silicon alloy was 1 in 96, which was lower than the figure in the other aluminium alloys.

* Discussion on a Paper presented by Capt. George Mortimer to the Annual Convention of the Institute of British Foundrymen.

A Member, interposing, said his experience when making aluminium pattern-plates was that they obtained "drawn" places. He was searching for a mixture which, if possible, would not draw, but one which could be relied upon to produce a plate which only required sandpapering before putting into production.

Mr. Tyson could not say that they would get any aluminium alloy which would be free from draws. It was the foundryman's job to overcome that by chilling or feeding. The finish on these pattern plates made from silicon alloy was very good, and came up almost as well as anything a good plate-maker could get, with a finish equal to any of the white metal alloys.

THE AUTHOR'S REPLY.

Captain George Mortimer thanked the Chairman and Mr. Cook and others for the very kind remarks they had made about his Paper, which had been totally unexpected by him. He had not anticipated that the discussion would have taken more than a few minutes; but as it developed it had raised very many interesting points. Dr. Budgen had dealt with the question concerning swarf, so he would not refer further to that. Mr. Markland had asked whether there was any harm in raising the temperature of a melt to round about 800 or 900 deg. C There was harm, and it was two-fold. In the first place, as soon as the temperature rose above about 740 deg., aluminium absorbed gases quite freely, and also oxidised freely. This would come out in the castings in the usual "speckled metal" so familiar to aluminium founders, and also in relatively brittle test bars with poor elongation. Secondly, there was a drawback to high melting temperatures which was rather a new point. In making a cast it was always desirable that the grain should be as refined as possible, with the smallest possible crystal-size: because the larger the grain the greater the tendency to "draws" and to cracks. It was perhaps somewhat surprising to know that, however low the pouring temperature used, the melting temperature largely influenced the crystal grain size in the resulting casting. Even if a melt was cooled down to the correct pouring temperature, a high melting temperature results in relatively coarse crystallisation. The lower the temperature and the shorter the time taken in melting, the closer and finer the crystal grain. That seemed a very important point, and also answered Mr. Jolley's question as to the desirability of his method of ridding a melt of gases by superheating by some 200 degrees. Undoubtedly this treatment freed the melt of certain entangled gases: also it increased the risk of dissolved gases. If Mr. Jolley's method were used, then the melt should be solidified and re-melted before pouring into castings, when the troubles due to dissolved gases and to coarse crystallisation would be largely neutralised.

Judicious Use of Scrap.

Although virgin ingot was always regarded as the best material, as in the case of cast-iron, it paid to introduce a certain percentage of good scrap, or to re-melt the ingot: it always produced better work, in his experience. In using brand new ingot of a high-grade one got very fine test-bars, but a tendency to "draws" and to cracks in the casting itself, which could be overcome by remelting or by judicious use of the founder's own selected scrap. Mr. McCullagh had asked whether any harm was done by introducing a chunk of scrap into a melt to check a rise in temperature. He thought that this was a very satisfactory way of cooling a melt down, because it was quick, and there was one side issue which was not without interest. The cold lump of scrap in falling to the bottom of the pot passed through liquid layers of alloy in turn, which were thereby solidified momentarily and remelted. There was nearly always an evolution of gas which could not be entirely accounted for by expanding gases within the scrap or by volatile substances on its surface. In other words, one had the Archbutt solidification and remelting method momentarily applied, and any effect should be beneficial rather than otherwise. Major Athey had asked whether the silicon content, raised to 1.7 per cent. in L8 caused a falling off in tensile strength. He had never noticed any falling in tensile strength by the judicious use of silicon, but only in ductility, and in L8 the ductility was in any case negligible. If the silicon content were raised to exceed the iron impurity content by 25 per cent., definitely better castings resulted: the iron complex caused "draws" and cracks, and if it could be converted into an iron silicide or a ternary iron-silicon-aluminium complex, it was then in a form which caused less foundry troubles.

Mr. Howard had asked whether there was any available information in regard to an alloy for resisting wear. A heat-treated casting of "Y" alloy, especially when chill-cast, offered the best wearing light alloy in the writer's experience, and was actually in use for the camshaft bearings of certain aero engines. He would not recommend any other alloy at present for this class of duty. He thought the question was largely one of the price the job would stand: heat-treated "Y" alloy was relatively expensive, and some of the high-copper alloys had excellent reputations for hard-wearing service, as witness the millions of L8 pistons in use. If, on the other hand, one merely wanted an alloy which would withstand knocking about, then the silicon alloys should be considered, because it was very difficult to crack up a silicon alloy casting or knock a piece off it. The silicon alloys, as modified, were remarkably malleable, particularly in the case of die castings: it was a very strong and useful material.

Machining Speeds of Aluminium Alloy Castings.

Mr. Gardom had asked what was the machining speed of aluminium alloy castings. Some loose terms were freely used in regard to these speeds, and it was claimed that these alloys could be machined at 1,000 feet per min., without any statement as to the depth of cut or rate of feed. It was always difficult to get actual facts from a customer, but there was no doubt whatever that these alloys could be machined at speeds far in excess of those possible on cast iron or brass. There was no doubt that cutting speeds of 1,000 feet per minute were used, and that the higher the speed used the better the finish, given reasonably light cuts and light feeds. It was a remarkable sight to see a large aeroplane engine crankcase being faced throughout its length by a high-speed fly-cutter within a few minutes. The only practical snag he had encountered in machining of aluminium castings was when, after supplying for a long period large numbers of L8 pistons, he had persuaded the customer to take heat-treated castings giving twice the Brinell hardness. These heat-treated pistons had gone straight into the routine machines with speeds and cuts normal to L8 of half the hardness, and the customer had been surprised because the fine edges of the tools "went west." The trouble was assigned to "hard spots," and the founder lost the job.

Mr. Logan had asked how they obtained nitrogen for the Archbutt treatment. It was obtained in the usual steel cylinders. He (the speaker) was pleased to have Mr. Logan's information as to the possibility of impurities in the gas so obtained: the presence of hydrogen and oxygen would account for a whole host of anomalies observed when using this method. With regard to the nitrogen treatment being a commercial proposition, there seemed to be little difficulty in application. Many of them were familiar with the old-fashioned poling operation, with a green-wood pole. If, instead, one provided an iron pipe, duly dressed with whiting and water-glass, and attached at one end to the nitrogen cylinder by a flexible tube, one could use this pipe as the usual pole. The nitrogen was turned on gently, and there was little ebullition worth the name: the metal was thoroughly stirred by the nitrogen from the bottom upwards and there was an intermittent burning of hydrogen at the surface. The chief objection to the process was the fact that to be really effective it must be carried out whilst the metal was cooling down and almost solidifying, when the bulk of gases was being released from the melt. There was then real risk of nitrogen becoming entangled in the solidifying metal and causing more trouble than it set out to remove. For this reason he himself had abandoned the method.

Experience of Perlit Pots.

Mr. Logan had asked his experience of Perlit pots, and whether he had found any real advantage from their use. As far as he could remember, trial pots lasted twice as long as the ones in normal service, but cost more than twice as much. There was a great opening for the iron foundry which could produce something good as a material in which to melt aluminium. Anyone could be sure of his market who could make a pot which would not readily scale on the outside nor readily go into solution with the melt on the inside, and he hoped that something in this direction might be done through the agency of the Cast Iron Research Association.

Mr. Dews asked whether anyone had actually taken up the Archbutt method commercially. Several founders used the pre-solidification method as a matter of routine on certain work: there were definite advantages derived. He referred to work on which the present-day standard of acceptance was very high indeed; it was no uncommon experience to receive from certain clients castings which had been neatly sectioned up and polished, and to receive with these specimens a covering letter drawing attention to several pinholes thus disclosed. He was not exaggerating when he said that in many instances these minute pinholes could not be seen with the naked eye, nor could they in some instances be located at all without the assistance of the covering letter. He did not quarrel with high standards of acceptance for this particular class of work, but if such standards had to be met, then one had to try out every possible means of improving the product. In such cases Mr. Archbutt's method gave quite well-defined results and was justified. They had found that there was an even more definite advantage in eliminating turbulence of the metal from the moment it was melted to the moment it set in the mould: as far as turbulence could be eliminated. For example, melting pots were carried to the mould bodily, and vast care taken in the design of the gates so that metal did not fall vertically any distance or meet abrupt changes of direction. If there were undue stirring, splashing on ladling, causing turbulence on entering the mould, then air got entangled; the oxygen, acting on the metal, was converted at once to alumina. the nitrogen remained entangled and caused as much pinholing as did dissolved gases coming out of solution. Mr. Dews later indicated that one was jumping too readily to conclusions in advocating these various methods of clarifying melts, and he entirely associated himself with Mr. Dews' remarks. That was why he had put the case in so reserved a manner. On page 7 of the preprint he had written that in spite of the useful lead given by science they were, as yet, only on the fringe of the subject, and it was his feeling that much of the necessary development of these useful scientific theories would lie with the founders themselves. He did not think any founder could claim absolute precision yet in producing castings free from pinholes: they themselves would not, but they felt that they were markedly nearer to this than they were three years ago.

Discrepancies in Light-Alloy Analyses.

Mr. McClelland had referred to the great discrepancy that sometimes existed between analyses of light alloys, especially in the case of analysis of one sample as received from opposing camps in a lawsuit. That was in fact a difficulty sometimes. A government department, for example, would sometimes refer to the analysis sent in by the founder with a certain batch of castings and claim that the proportions as ascertained by their chemists differed from those of the founder. The founder would have a check analysis made and find it in order, but to make the matter certain he would send the sample for independent check by some well-known personality such as the City Analyst. The results of this were often even more confusing; the expert's analysis differing widely from both founder's and customer's results.

Mr. Harley had referred to the value of distributing gates, and he was entirely with him. A large runner might be split up into many small sprues, carefully distributed throughout the casting, with great advantage in the case of these

light alloys. It was common practice at the Mills foundry and at many others within his knowledge.

He was glad to have a member's support as to the practical value of an integral cast coupon in addition to the standard test bar, for checking the fracture of the actual casting in the case of modified silicon-alloy sand castings. Mr. Lambert had pointed out, very pertinently, that it was time something was done to round up the various light alloys, of which there were now literally hundreds. In a large foundry working on a great variety of patterns and using, as they were, eight or nine different alloys, all having the same colour and appearance, the practical difficulty of tracing scrap and spillings back to their correct bins, without getting them mixed, was a very real one. It was done year in and year out with success, but only by very close organisation. When in addition one received small orders in some special mixture of no very special properties, it caused much trouble for no practical advantage. It was peculiarly irritating, for example, to receive, as they did time and again, an order for about twelve pistons in an alloy containing zinc. Zinc is not suitable for pistons or other high-temperature work, and it was up to the Institute of British Foundrymen to use their influence in the direction of educating customers in these matters, and to do what they could to steer the public into using only the B.E.S.A. specifications, which covered the whole field likely to be touched. The main exception was the field of marine castings; he thought the B.E.S.A. had not yet issued a specification for modified silicon-alloy castings.

Test-Bar Specification Employing a Chill-Cast Test-Bar.

Mr. Jolley had asked who was responsible for a test-bar specification employing a chill-cast test bar. On the face of it, this did seem rather absurd as a test for sand castings, and we were the only people in the world who did it; we were even, in fact, rather like the Irishman in the regiment, who said all the rest were out of step. As a matter of fact, however, there was a good deal to be said for the chill-cast bar, and for the following reasons:—One could never say that any test bar really represented the strength of a casting, because the question at once arose as to which part of the casting it represented. Owing to change in direction and section, to intricate core work, local chilling or feeding, castings varied in physical properties throughout their different parts. The British Engineering Standards Association, realising that no test bar could give an idea of the strength of a casting with any accuracy, decided that at any rate their test should definitely indicate the quality of the metal going into the casting. A sand-cast bar might or might not do this; so much depended on the individual skill of the test-bar maker. Some men could make very beautiful test bars in sand from one year's end to another, and others could not. If a man were trained to it, then he might go sick, and the founder might find that all his castings go down on test, though they were as good as before and the metal the same as before. In other words, the sand-cast bar brought in many factors additional to that of the simple quality of the metal. The chill-cast bar aimed at eliminating unknown factors other than the quality of the metal. Considered thus, as a datum line wherewith to compare the properties of different melts or of new alloys, the chill-cast bar appeared to offer a more stable datum line than a sand-cast bar. Once the procedure for casting the bars was standardised, it was difficult to get any serious variation in test-bar results unless accompanied by a definite change in the quality of the melt, such as might be caused by stewing good metal or by taking up iron into solution from pots. That, at any rate, was what was aimed at, and once the general principle was grasped, then it did seem that the chill-cast bar might give a more reliable standard for comparison than the sand-cast; but it had to be admitted that they were the only people who had standardised this class of test bar.

He thought he had replied to all the questions asked, but if any had been omitted he would ask the questioner to write, when he would be pleased to give him a written answer. He wanted to thank them for a most interesting discussion. It had been a considerable surprise to him, as he had not thought that the reading and discussion of the Paper would occupy much more than ten or twenty minutes. He had thoroughly enjoyed the morning and their remarks, many of which had been definitely helpful to him personally.

Vote of Thanks to the Author.

The CHAIRMAN (Mr. Wesley Lambert), in proposing a vote of thanks to Mr. Mortimer, felt sure, after the remarks of one of the speakers with reference to chemical analyses, that a number of the audience had some doubts as to the abilities of the analytical chemist. Having served as an analyst for a good many years, he wanted to say that it was useless sending a sample of metal to a city analyst unless the city analyst had an assistant who was fully qualified to conduct an analysis of that particular metal. No one would think of sending a sample of beer to a dye works. (Laughter.) They would have to have some understanding in the trade that if a certain firm of repute supplied a casting, and a government department, or any other customer, disputed the analysis, the matter should be referred to another producing firm, with a staff of qualified analysts experienced in that particular metal. The analysis of aluminium alloys had become very complicated, and, therefore, it behoved them more than ever to select a man who was able to handle the reference sample. He thought the Institute of British Foundrymen probably would have to consider that matter before very long, and he was very pleased that the point had been raised. There were many analysts who could make correct analyses of aluminium alloys. It was very regrettable that there should be any discrepancies, but those discrepancies should be of such a minor character as to be of no importance to anyone who could interpret the analysis correctly.

The PRESIDENT (Mr. S. H. Russell) briefly seconded the vote of thanks, which was carried with acclamation.

Enamelled Hollow-ware.

Import Duty to be Imposed.

On November 2, 1925, the Board of Trade, under the Safeguarding of Industries Act, appointed a Committee to inquire into and report upon an application from the Enamelled Hollow-ware Section of the Wrought Hollow-ware Trade Employers' Association for the imposition of a duty on enamelled hollow-ware. For several reasons then given, the Board were unable to support the applicants' claim. The position, however, as regards imports became more serious and the Committee was re-appointed on March 6, 1928, further to inquire into the application.

In the course of their Report the Committee say that importation indicates an increasing tendency, especially when viewed with regard to the trade as a whole, and the almost negligible re-export business. The following figures support this view:—

Imports of Wrought Enamelled Hollow-ware.

	Imports.	Retained imports.
	Tons.	Tons.
1920	3,643	3,468
1921	7,676	7,634
1922 (*a*)	8,592	8,508
1923 (*a*)	5,747	5,616
1924 (*a*)	5,821	5,762
1925	7,885	7,821
1926 (*b*)	7,285	7,195
1927	9,754	9,690

(*a*) A duty of 33⅓ per cent. *ad valorem* in force against German imports only from August 23, 1922, to August 20, 1924.

(*b*) General strike and coal stoppage year.

It will be noted, says the Committee, that the average importation for 1921 and 1922, the two years considered at their last inquiry as most fair and normal for comparative purposes, was 8,134 tons, while that for 1926 and 1927, the two new years under review, the figure rises to 8,519 tons. Corresponding figures for imports retained here are 8,071 tons, the average for 1921 and 1922, and 8,442 tons, that for 1926 and 1927. Both the home production and the exports of home produce show a downward tendency in recent years.

Wages Compared.

The following statement indicates the minimum rates per hour payable for the various classes of labour in Great Britain:—

Male workers.		Female workers (18 years and over.)	
Skilled.	Unskilled.	Time-rate.	Piece-work basis, time rate.
1s. 6d. less 5 per cent.	11½d.	6¾d.	7½d.

In the case of male workers, the piece-work basis time rate is usually in the neighbourhood of 25 per cent. above the time rate for the corresponding class of worker. In Belgium, according to the official Brussels Wage Sheet for November, 1927, the rates paid to skilled male workers in this trade varied from 3.50 francs to 4.00 francs per hour (or from 4.8d. to 5.5d. per hr.), while unskilled male workers received 3.00 francs (or 4.1d.) per hr., and women workers 2.00 francs (or 2¾d.) per hour. So far as Germany is concerned, it would appear from evidence given to the Committee that the minimum time rate paid to skilled male workers corresponds to 10d. to 1s. per hr., while the rate paid to unskilled labour corresponds with approximately 9½d. per hr. The hours of labour in Germany, the only country in respect of which evidence on this question was submitted, are, normally, restricted to 48 hrs. per week, and are, therefore, nominally little in excess of those current in the industry in this country. In many instances, however, overtime is regularly worked, and although paid for at increased rates is looked upon as part of the normal hours of labour.

The Committee find that while those Continental countries referred to now incline to shorter hours of work per week and increasing remuneration, the latter is still materially below the remuneration obtaining in this country, while the real hours worked are longer than those ruling in Great Britain. Due to further evidence and the knowledge gained from Professor Kirkaldy's visits to seven of the English works, the Committee are satisfied that the industry is being conducted with reasonable efficiency and economy, and after a careful review of the evidence from both parties and consideration of the industry's position as a whole, desire to recommend that a duty of 25 per cent. *ad valorem* be imposed on all imported wrought enamelled hollow-ware (whether of iron or steel) for domestic use, except children's toys, and that such a duty should prevail for at least five years from the date of its adoption. A resolution passed by the House of Commons recently accepted the recommendation, which will be put into force.

Launch of H.M.S. "Medway."

The launch of another vessel for the British Navy took place at the Naval Construction Works, Barrow-in-Furness, last Thursday, when H.M.S. "Medway" was christened and launched by Lady Chatfield, the wife of Vice-Admiral Sir A. Ernle Chatfield, K.C.B., K.C.M.G., the Third Sea Lord and Controller of the Navy. The "Medway" is a steel twin-screw vessel, 545 ft. B.P., and has been built to act as a depôt and repair ship for submarine flotillas. She has ample internal space to accommodate, in addition to her own complement and repair staff, the whole of the officers and crews of the submarines attached to her. The vessel is specially designed for prolonged service in tropical as well as cold climates.

The workshops include foundry, machine shop, plate shop and smithy, torpedo shop, plumbers' shop, etc., of large areas, which are fitted up with all necessary machines, etc., to carry out repair work in connection with submarines.

The main propelling machinery of the ship consists of a pair of double-acting, two-stroke internal combustion engines, made by Messrs. Vickers-Armstrongs, Limited, under licence from Messrs. Maschinenfabrik Augsburg-Nurnberg, A.F. Each engine has four cylinders, and is designed to develop 4,000 brake horse power at about 115 r.p.m.

The bedplates, which are of the flat-bottomed type, and the scavenge pumps, which are engine driven and of the tandem double acting type, are of Barrow design. In many points of detail slight alterations have been made to meet British practice or Admiralty requirements. Solid injection not having yet been developed for these engines, the normal air injection system is used.

British Facilities for Foundry Training.

No. IV.—THE METALLURGICAL DEPARTMENT OF THE UNIVERSITY OF BIRMINGHAM.

By Percy Fox-Allin, Associate Editor of "The Foundry Trade Journal."

At Birmingham, more perhaps than at any other of our universities, there are existing facilities for combining the practical with the scientific training. "Feeney Professor" Dr. D. Hanson, D.Sc. (Liverpool), has very pronounced views regarding the necessity of co-ordinating, so far as is practical within the scope of a university training, theory and practice.

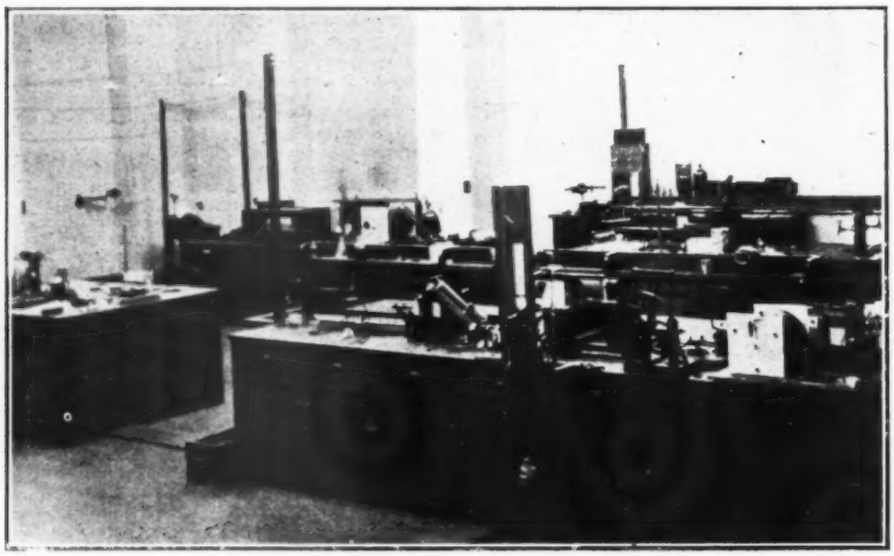


Fig. 1.—A Portion of the Main Research Laboratory. The Metallurgical Department of the University of Birmingham.

All students proceeding to a degree in metallurgy must afford satisfactory evidence that they have during their course of study regularly attended, for a period of at least equal to a university term, at some metallurgical establishment previously approved by the Professor, and in due course to give accurate descriptions of the plant and of the processes in which they have taken part. A considerable number of firms engaged in both the ferrous and non-ferrous metallurgical industries have extended facilities for the students to qualify in this direction. It is, however, significant that very few foundries are represented in the list. It may be that this is due to the fact that the manufacturers concerned have not been approached on the matter, as no special course has been laid down for the foundry student. Generally speaking the foundry is regarded as a component part of the engineering department; indeed, this is the case at Birmingham, where attached to the engineering department are really well-equipped pattern shops and foundry. Clearly, however, the student desirous of taking up foundry work would not take the full engineering course, a thorough knowledge of the metallurgical side of his industry is of infinitely greater moment. In the metallurgical department the foundry forms little more than an aid to the study of metallurgy, and cannot be regarded as representative even in a miniature form of practical foundry work.

If owners of foundries could see their way to offer the same facilities to students as are existing in many of the large iron and steel works, rolling mills, and works engaged in the non-ferrous metals industries, the student training for the founding industry would be in a position to reap the fullest possible benefit from his metallurgical training at the university.

Equipment.

The metallurgical laboratories at the Birmingham University are well-equipped with modern appliances. In addition to large and commodious laboratories for wet and dry assay of metallurgical materials, special rooms are assigned for practical metallography and photo-micrography, and for pyrometry and physical metallurgy.

The equipment includes:—Zeiss and Reichert metallograph cameras, resistance thermo-electric, radiation and optical pyrometers, recording pyrometers and potentiometers, plotting chronograph and apparatus for thermal analysis, electric and gas-fired annealing and heat-treatment furnaces. A well-equipped workshop contains lathes, milling machines and general machine tools, together with a wire-drawing bench.

The mechanical testing shop contains a 30-ton machine for tension, compression and bending tests, 120 ft.-lb. Izod impact tester, Brinell hardness testing machines, and a Wohler fatigue-testing machine.

Melting Shop.

As already stated the possibilities for practical work are unique, in conjunction with a university training. Indeed, the foundry, smelting and heat-treatment laboratories contain semi-large-scale plant well above what is usually considered necessary for experimental work. The equipment includes an Ajax Northrup high-frequency furnace, in which 25-lb. charges of pure iron can be brought down. There are three coke-pit furnaces, and one gas-fired pit furnace, in which last pure iron is also capable of being rapidly melted. A Morgan tilting-crucible furnace is also installed. The apparatus for heat-treatment consists of a gas-fired furnace by the Incandescent Heat Co. and a Leeds and Northrup electric furnace with automatic temperature controller and potentiometer recorder. There is also a large air furnace, which, however, is not usually in service. There is a Taylor and Challen rolling mill, which can be adapted for hot or cold rolling as also for the production of sections: this mill is driven through machine-cut gearing by a 25-h.p. motor of the Lancashire Dynamo and Motor Co.'s manufacture. Pre-heating for the mill is normally done in an electric-tube furnace. There is a drop stamp with 84 lbs. tup.

Non-Ferrous Activities.

In an annexe there is a small blast furnace suitable for copper and lead smelting, a reverberatory furnace, and crushing and weighing machines are also available for smelting processes. A 40-kw. motor-alternator set by the E.C.C. supplies the current for the high-frequency furnace, and is available with a static transformer, for use with other high-temperature furnaces. In all cases the students make their own castings.

Housed in an adjoining room is the laboratory, which is under the control of the British Non-Ferrous Metals Association. A room is laid off

(*Continued on page* 65.)

Fig. 2.—Metallurgical Museum. The Metallurgical Department of the University of Birmingham.

FIG. 3.—A PORTION OF THE ASSAY LABORATORY. THE METALLURGICAL DEPARTMENT OF THE UNIVERSITY OF BIRMINGHAM.

FIG. 4.—A PORTION OF THE METALLURGICAL TECHNOLOGY LABORATORY. THE METALLURGICAL DEPARTMENT OF THE UNIVERSITY OF BIRMINGHAM.

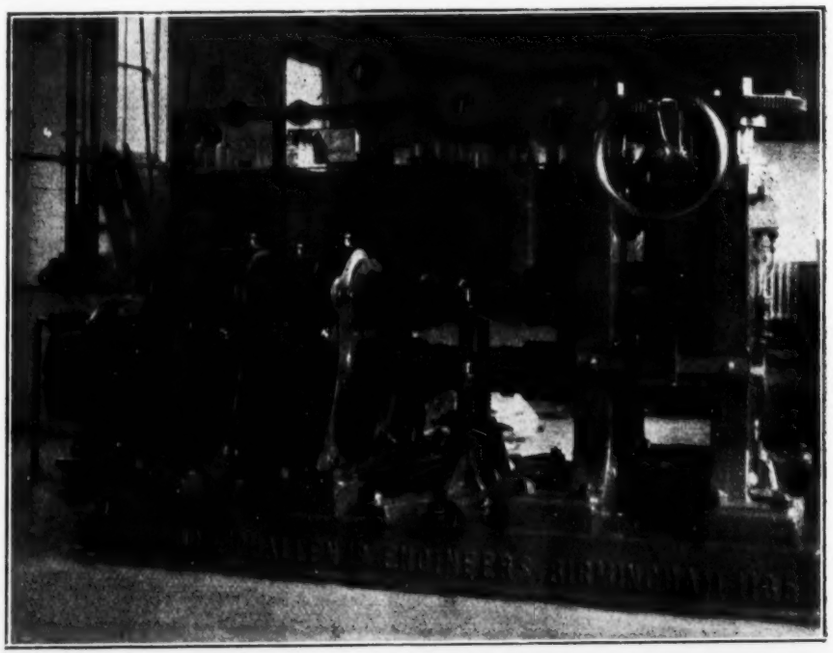


FIG. 5.—ROLLING MILL. THE METALLURGICAL DEPARTMENT OF THE UNIVERSITY OF BIRMINGHAM.

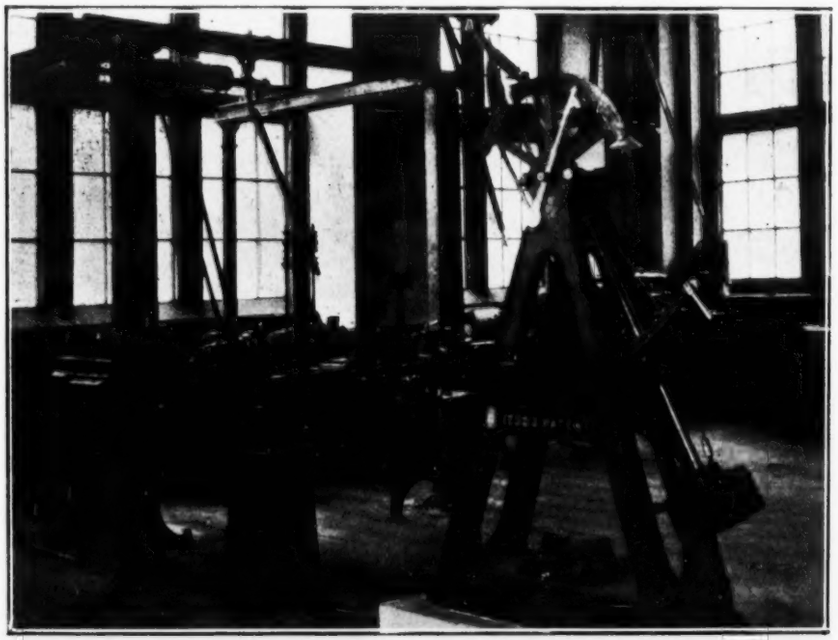


FIG. 6.—A CORNER OF THE MACHINE SHOP AND MECHANICAL TESTING ROOM, SHOWING AN IZOD IMPACT TESTING MACHINE. THE METALLURGICAL DEPARTMENT OF THE UNIVERSITY OF BIRMINGHAM.

Second Report on the Heterogeneity of Steel Ingots.*

By a Committee of the Iron and Steel Institute.

[*Abridged.*]

(*Continued from page* 393.)

In Table VIII (XVII in the Report) will be found the general particulars concerning the ingots dealt with. The data from Examples 24, 25, 26, 27, 28, 30 and 31 are presented as representative of this class of material. Examples 24 and 26 present features very different from those of an ingot of completely "killed" steel. These ingots represent steel cast in such a condition that the ingot contains blowholes, and they show the very marked effect produced by the gas liberated during freezing, while Examples 27 and 25 are in descending order of gas evolution. In the manufacture of steel such as Examples 24 and 25 it is essential that the liquid metal shall evolve large amounts of gas. This is attained (1) by working with a particular kind of slag, and (2) by making no addition of the "killing" agents, silicon and aluminium.

The data from Example 29 are presented on account of the particular interest of the effect of the high sulphur and phosphorus contents. In the manufacture of this steel very little silicon is added, and yet the ingot shows none of the characteristics of "wild" steel. The additions of sulphur exercise a killing effect, which minimises the liberation of gas, and produces an ingot with the usual features of a "solid" or piping steel ingot. For this reason the steel is cast in moulds with the wide end up and with a feeder-head.

The study of Example 32 is included in this section as illustrating the effect of the practice of casting piping steel in the old type of mould, which produced an ingot heavier in section at the bottom than at the top, and which was not provided with any suitable refractory-lined feeder-head for preventing the formation of pipe in the body of the ingot.

Example 24; *Tube Steel Ingot.*—This ingot is made of steel of the rimming type; it left the launder at 1,635 deg. C., and is the kind used for tube manufacture by the Pilger process. The data given are analyses, Figs. 18, *a* to *e*, and nitric-acid etching print, Fig. 18, *g*.

In the nitric-acid etching print four zones may be distinguished:—(1) A thin solid outer shell about $\frac{1}{2}$ in. thick. (2) A zone about 4 in. thick all round the ingot, free from segregation, but containing numerous elongated blowholes, especially in the bottom half of the ingot. These holes are free from segregate. (3) A thin envelope of highly segregated material containing numerous blowholes of globular form. (4) The centre of the ingot, which appears to be more impure than Zone 2, and the upper portion of which contains blowholes, both with and without segregate. This is no major pipe cavity, but there are shrinkage cavities in the centre of the ingot, and traces of the V-segregate. In the lower half of the central zone a particularly unsound area, containing segregated areas of peculiar form, is seen.

The pit sample analysis was:—Carbon, 0.064; manganese, 0.350; silicon, 0.012; sulphur, 0.039; phosphorus, 0.010 per cent. From this it will be seen that Zone 2 is approximately the same in carbon, silicon, and manganese content as the pit sample, but is lower in sulphur and phosphorus. In Zone 3 there is a concentration of carbon and sulphur. In Zone 4 the carbon, sulphur, and phos-

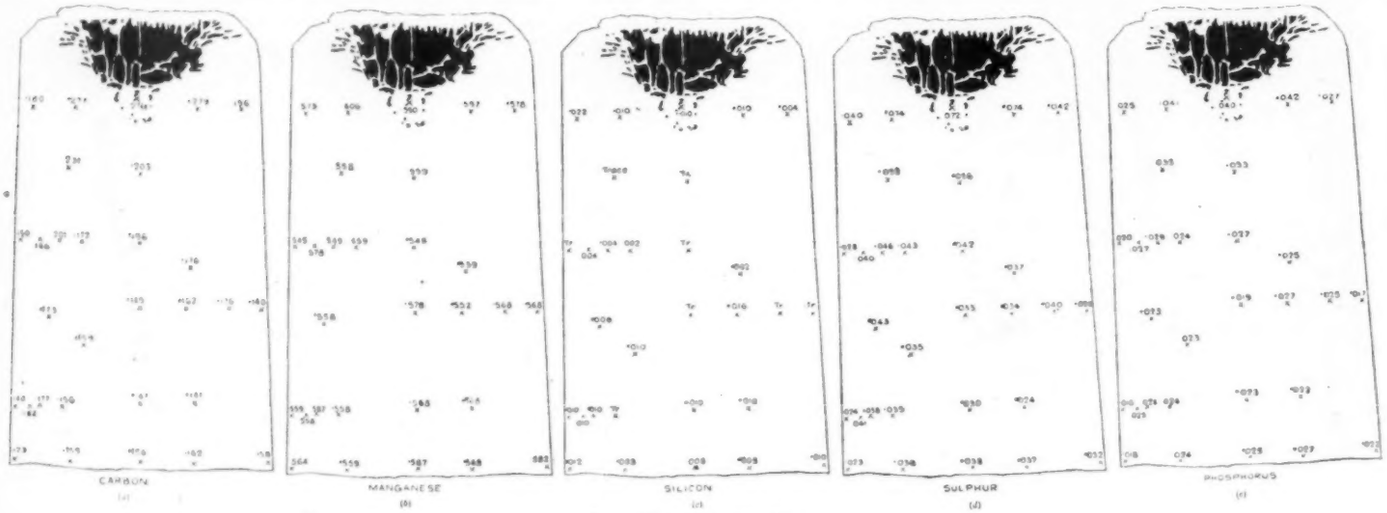


FIG. 20.—EXAMPLE 26.

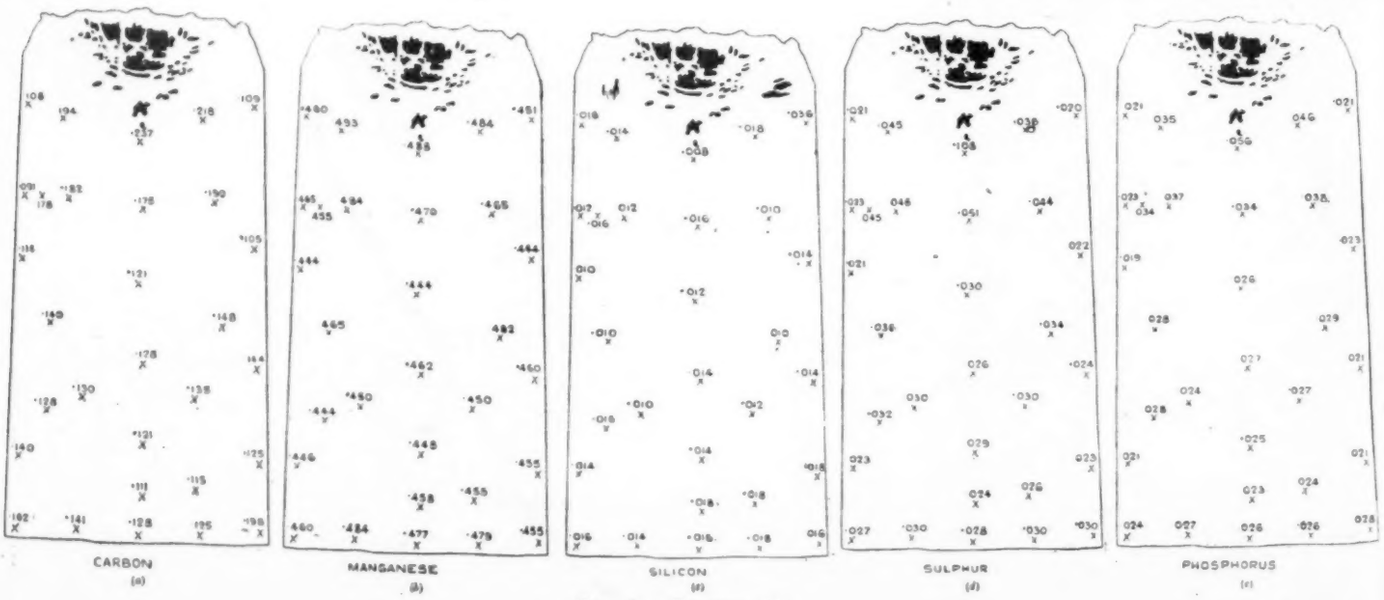


FIG. 21.—EXAMPLE 27.

* A Paper read before the May Meeting of the Iron and Steel Institute.

FIG. 20 (*g*).—MACRO-ETCHING. EXAMPLE 26.

FIG. 21 (*g*).—MACRO-ETCHING. EXAMPLE 27.

phorus are generally higher than in the pit sample, with a concentration of these elements in the top third of the ingot.

From the above it would appear that after the metal has entered the mould a very thin skin first freezes, exactly as in the case of "killed" steel. Next, columnar crystals grow, and the segregates would appear to be less than in the still liquid steel in the centre; hence, in a measure, these columnar crystals appear to be of modified composition, and thus are found to be more pure than the original pit sample. During this period the impure "mother-liquor" which has been carried into the liquid steel diffuses generally, but a certain amount is later found at the top of the ingot.

The rate of freezing slows down considerably owing to the thickness of the advancing wall, the heating up of the mould, etc., and the liquid steel in the centre would appear to begin to crystallise at various points, commencing at the bottom of the ingot. The result is that the layer of carbon-, sulphur-, and phosphorus-rich mother-liquid at the face of the chill crystals cannot readily diffuse, neither can the gases fully escape. They become

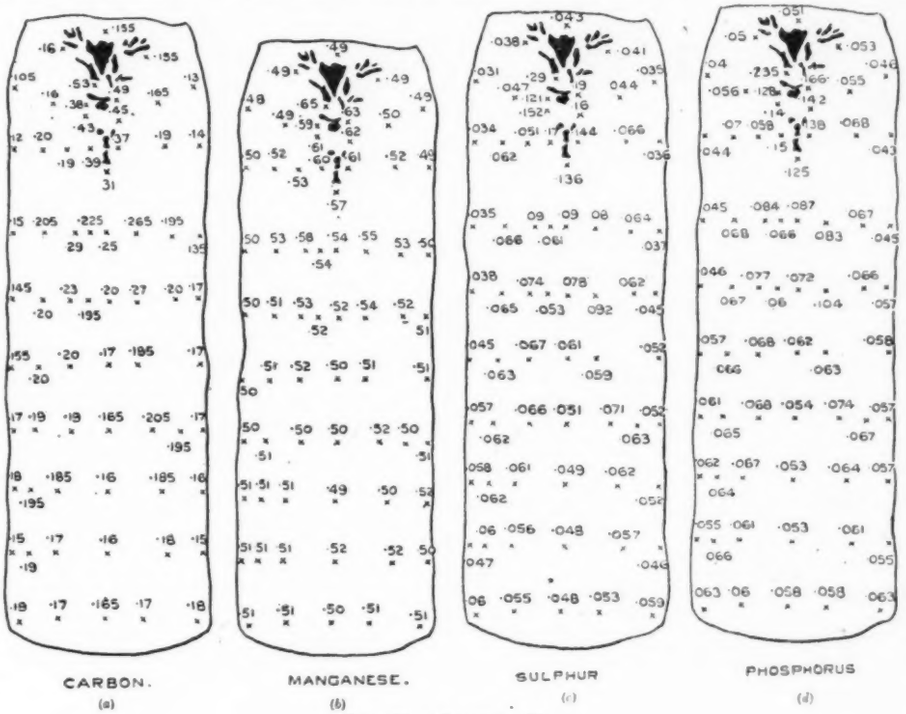


FIG. 22.—EXAMPLE 28.

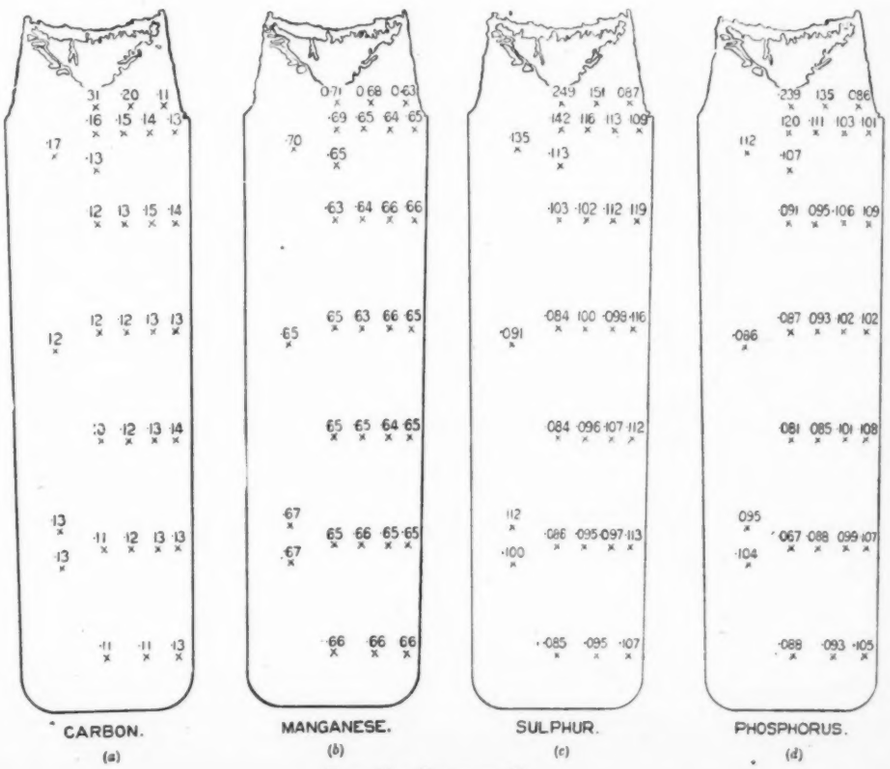
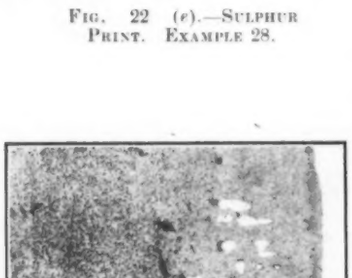


FIG. 23.—EXAMPLE 29.

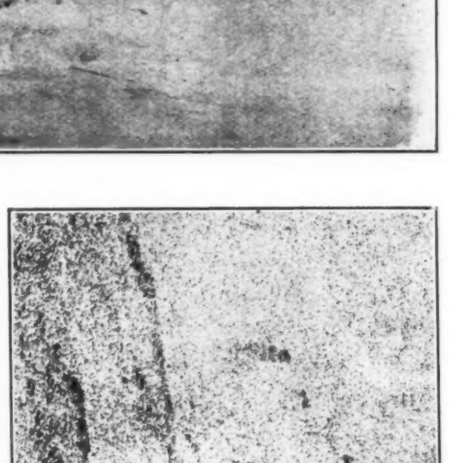
wedged in between the two sets of crystals, and thus, apparently, Zone 3 may be accounted for.

With reference to the blowholes seen in Zone 2, carried the impure mother-liquid away, and that they owe their shape mainly to the growth of the outer crystals at the time of their formation.

FIG. 22 (*e*).—SULPHUR PRINT. EXAMPLE 28.



(*f*) Sulphur Print (to a larger scale) of one Edge of Ingot about 1 ft. from Top.



(*g*) A Blowhole into which rising Segregate appears to have flowed.

FIG. 22.—EXAMPLE 28.

TABLE VIII.—*Details of Carbon-Steel Ingots.*

Example	Description of ingot.	Weight.	Size.	Kind of steel.	Analyses. Per cent.					Mould.
					C.	Mn.	Si.	S.	P.	
		Tons. Cwt.								
24	Rectangular	3 1	Top, 23¼ in. × 17½ in.; bottom, 21 in. × 15 in.; length, 4 ft. 11¼ in.	Basic Siemens tube steel	0.064	0.35	0.012	0.039	0.01	*G**
25	Rectangular	6 15	Top, 2 ft. 9⅛ in. × 1 ft. 9⅞ in.; bottom, 3 ft. 1 in. × 2 ft. 0⅜ in.; length, 6 ft. 3 in.	Acid Siemens plate steel	0.10	0.49	0.012	0.037	0.036	*J*
26	Rectangular	7 15	Top, 3 ft. 3⅛ in. × 1 ft. 10½ in.; bottom, 3 ft. 7 in. × 2 ft. 0 in.; length, 6 ft. 5½ in.	Acid Siemens plate steel	0.14	0.52	0.024	0.039	0.024	*K*
27	Rectangular	6 15	Top, 2 ft. 9⅛ in. × 1 ft. 9⅞ in.; bottom, 3 ft. 1 in. × 2 ft. 0⅜ in.; length, 6 ft. 3 in.	Acid Siemens plate steel	0.13	0.48	0.02	0.039	0.024	*J*
28	Rectangular	8 0	3 ft. 4in. × 2 ft. 1 in. parallel. L., 6 ft. 9 in.	Acid open-hearth plate steel	0.15	0.49	—	0.059	0.061	*M*
29	Square, with feeder-head	3 6	21 in. sq. at shoulder; 19 in. sq. at base; length, 5 ft. 6 in. in chill.	Basic free-cutting steel	0.12	0.66	0.03	0.113	0.098	*I*
30	Rectangular	7 14	Top, 2 ft. 10 in. × 2 ft.; bottom, 3 ft. × 2 ft 2 in.; length, 6 ft. 6 in.	Plate steel	0.19	0.51	0.075	0.041	0.042	*L*
31	Rectangular	7 14		Plate steel	0.13	0.50	—	0.033	0.020	*L*
32	Bottom-cast octagonal	1 3¼	10½ in. across flats at top; 14¾ in. across flats at bottom; length, 5 ft. 10¼ in.	Acid Siemens	0.63	0.66	0.21	0.048	0.044	*B*

* Without feeder-top.

and which contain little segregate, it seems highly probable that these developed after the main evolution of gas from the outer layer of crystals had Likewise, the globular blowholes seen in Zone 3 appear to have formed after the centre of the ingot had become "mushy," and when the segregate was trapped between the two sets of crystals. An explanation of the unsoundness of the bottom of this ingot has not yet been found, but it is possible that the condition of the bottom plates played some part in this.

Example 25; *Plate-Steel Ingot.*—This ingot, of the semi-killed variety, represents a type of ingot commonly used for boiler-plates and plates for general purposes. It is usual, however, to employ only the bottom half for boiler-plates. The temperature of the steel when passing down the launder was 1,615 deg. C. The data given are analyses, Fig. 19, *a* to *e*, and nitric etching print, Fig. 19, *g*. Details of the mould (J) are given in Fig. 4. In examination of the nitric etching print the following features are observable:—(1) A thin solid outer skin about ½ in. thick. (2) A columnar crystal zone varying from 2 in. to 3 in. in thickness, in which numerous gas cavities are seen; these are elongated, and in some cases appear to contain segregates. (3) A zone of conical shape containing the ∧-segregate, as seen in killed steel. At many points this segregate is pierced by blowholes. (4) The centre of the ingot, the lower half of which contains the ∨-segregate and shrinkage cavities, whilst the upper half contains shrinkage cavities, blowholes, and massive segregated areas.

The pit sample analysis was:—Carbon, 0.10; manganese, 0.490; silicon, 0.012; sulphur, 0.037; phosphorus, 0.036 per cent. It is obvious that the composition of Zone 1 is practically that of the pit sample, so far as carbon, silicon, and manganese are concerned, whilst the sulphur and phosphorus are lower. Zone 2 is a little higher in carbon than the pit sample, but very little higher in sulphur and phosphorus, except where actual segregated blowholes have been drilled. Zone 3 is high in carbon, sulphur and phosphorus, whilst the centre of the ingot has increasing amounts of carbon, sulphur, and phosphorus from the bottom upwards. The high silicon content at the bottom of this ingot is perhaps due rather to the presence of refractory material in the mould than to any freezing effect. The composition of the pool of segregate found at the top of this ingot is interesting:—Carbon, 0.412; manganese, 0.611; silicon, 0.004; sulphur, 0.286; phosphorus, 0.186 per cent.

This ingot appears to be intermediate, in many respects, between the rimming steel ingot, Example 24, and a killed-steel ingot; there is a well-defined ∧-segregate and very marked segregation at the top of the ingot. Casting records show that this steel was on the cold side, and this no doubt accounts for the presence of blowholes containing segregate so near the skin of the ingot, and for the large number found with the ∧-segregate.

The absence of any large number of blowholes at the bottom of the ingot indicates that the rate of cooling was comparatively slow, and that much of the gas escaped before any serious interference due to the freezing of the steel occurred.

Example 26; *Plate-Steel Ingot.*—This ingot is of the same type as Example 25, but it was cast 30 deg. C. hotter, the steel running down the launder at a temperature of 1,645 deg. C. (corrected), and at a somewhat slower rate. The data given are analyses, Figs. 20, *a* to *e*, and nitric etching print, Fig. 20, *g*. Details of the mould (K) are given in Fig. 5.

In this ingot six zones are recognisable:—(1) A thin solid outer skin ½ in. deep. (2) A chill crystal zone 2 in. thick, containing elongated blowholes, but which are free from segregate. (3) A layer of blowholes containing segregate. (4) A conical area between Zone 3 and Zone 5 free from segregate or blowholes. (5) The ∧-segregate. (6) The centre of the ingot. This was sound at the bottom, but contained isolated segregates higher up, and cavities and segregate towards the top end.

The pit sample analysis was:—Carbon, 0.14; manganese, 0.52; silicon, 0.024; sulphur, 0.039; phosphorus, 0.024 per cent. The analysis reveals characteristics in this ingot similar to those in the previous one, with the exception that the silicon is exceptionally low throughout the whole ingot.

Zones 1 and 2 have practically the same carbon and manganese contents as the pit sample, but the sulphur and phosphorus are lower. Zone 4 is somewhat high in carbon, but normal in sulphur and phosphorus; whilst Zone 5, the ∧-segregate, is high in carbon, sulphur, and phosphorus, and

increasingly so towards the top end of the ingot. Zone 6, the centre of the ingot, has practically the same composition as the pit sample at the bottom end, but increases in carbon, sulphur, and phosphorus towards the top end.

The data from this ingot indicate that the higher casting temperature and the slower rate of teeming have allowed the gas to get away more readily, and, further, have resulted in the minimisation of segregation. It is apparent that the position of the ∧-segregate is closely connected with teeming conditions—temperature, rate of pouring, and degree of wildness. The very low silicon result is difficult to explain, and is by no means an uncommon occurrence in steel of this class.

Example 27; *Plate-Steel Ingot.*—This is of the same type as Example 26, cast rather on the cold side (the temperature at the launder was 1,625 deg. C., corrected), and slowly, but the steel was much "wilder." The data given are analyses, Figs. 21, *a* to *e*, and nitric etching print, Fig. 21, *g*. Details of the mould (J) are given in Fig. 4.

In examination of the nitric etching print, four zones are to be seen:—(1) A very thin outer shell. (2) A shell varying from 2 in. to 4 in. in thickness. The first 1½ in. of this is solid, but the remainder contains numerous large gas cavities. A few of these contain segregates, but most of them are free from such matter. (3) A conical zone containing segregates of the ∧-type, but relatively few blowholes. (4) The centre of the ingot—sound and free from segregation at the bottom, but having the well-defined ∨-segregate on the centre line, also cavities of the shrinkage type.

The pit sample and analysis was:—Carbon, 0.130; manganese, 0.480; silicon, 0.020; sulphur, 0.039; phosphorus, 0.024 per cent. The distribution of the various elements in this ingot is very similar to that in the previous ingot, with the exception that Zone 2 is somewhat high in carbon at the bottom end of the ingot and low towards the top; also, the centre line of the ingot is surprisingly free from segregation, except, of course, at the top end. The silicon, it will be noticed, is also low throughout the ingot, as compared with the pit sample.

The data obtained from this ingot yield similar conclusions to those previously arrived at with respect to Examples 25 and 26. Had the casting temperature been higher, it seems probable that much of the gas forming the blowholes in Zone 2 would have escaped to the top of the ingot, and in so doing would have removed with them much of the segregate found in Zone 3.

Example 28; *Plate-Steel Ingot.*—This ingot was made by the acid open-hearth process. It was top-cast into a parallel split mould, M, Fig. 7, the temperature of the furnace (back wall) being 1,590 deg. C., and of the steel in the launder 1,615 deg. C. The rate of teeming was 3½ tons per minute. The charge contained 70 per cent. of steel scrap. One ton of ore (Fe_2O_3, 89 per cent.) was used to work the charge, and no limestone. The ferro-manganese was added to the ladle.

The pit sample analysis was:—Carbon, 0.155; manganese, 0.49; sulphur, 0.059; phosphorus, 0.061 per cent. The analysis of the tapping slag was:—SiO_2 = 52.5; FeO = 27.4; MnO = 13.2; CaO = 0.75; MgO = 0.34; Al_2O_3 = 4.9; TiO_2 = 0.25 per cent.

The data given include analyses of drillings taken at different points on the half-section, Figs. 22, *a* to *d*, and sulphur prints, Figs. 22, *e* to *g*. The sulphur print shows a thin outer shell of steel, increasing in thickness towards the top, of greater purity than the average composition. Its presence is also indicated by the analyses of the skin drillings. This zone is more clearly seen in Fig. 22 *f*, which shows a half-size section of the sulphur print taken at one edge about 1 ft. from the top. It is noteworthy that the widening of the zone in the upper part coincides with a gradual increase in number and size of subcutaneous blowholes. There can be no doubt that the beginnings are here seen of a type of heterogeneity, illustrated by Example 24, common to all unkilled or partly killed low-carbon steels. The ∧-segregates are

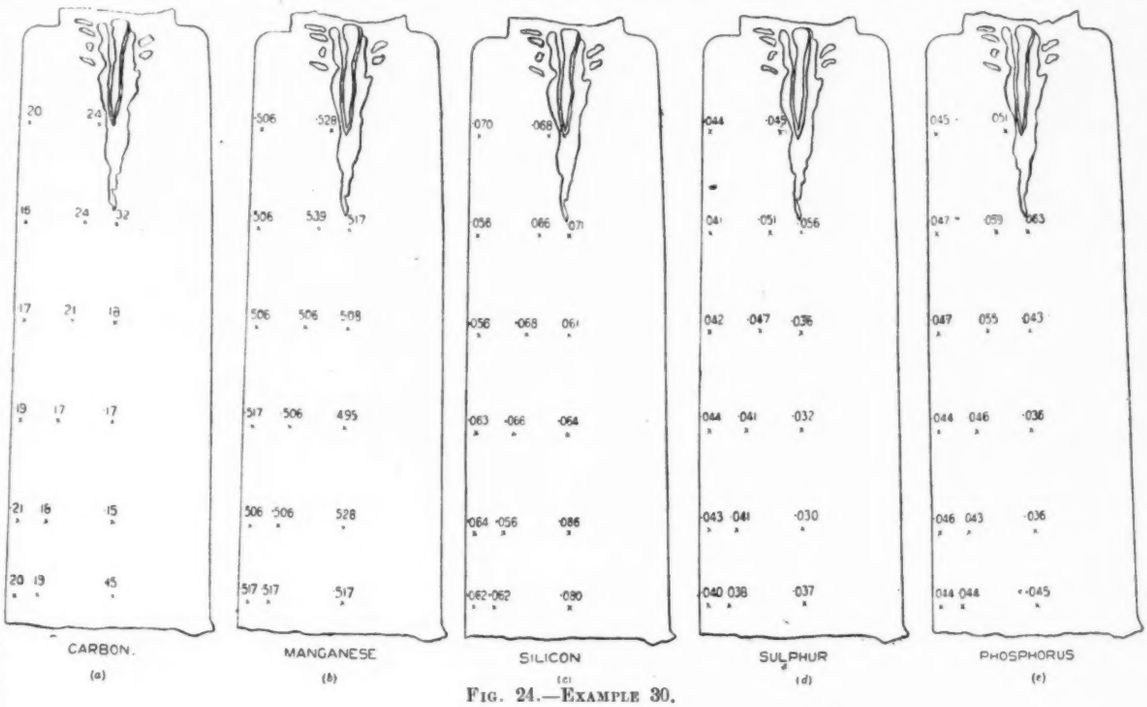


FIG. 24.—EXAMPLE 30.

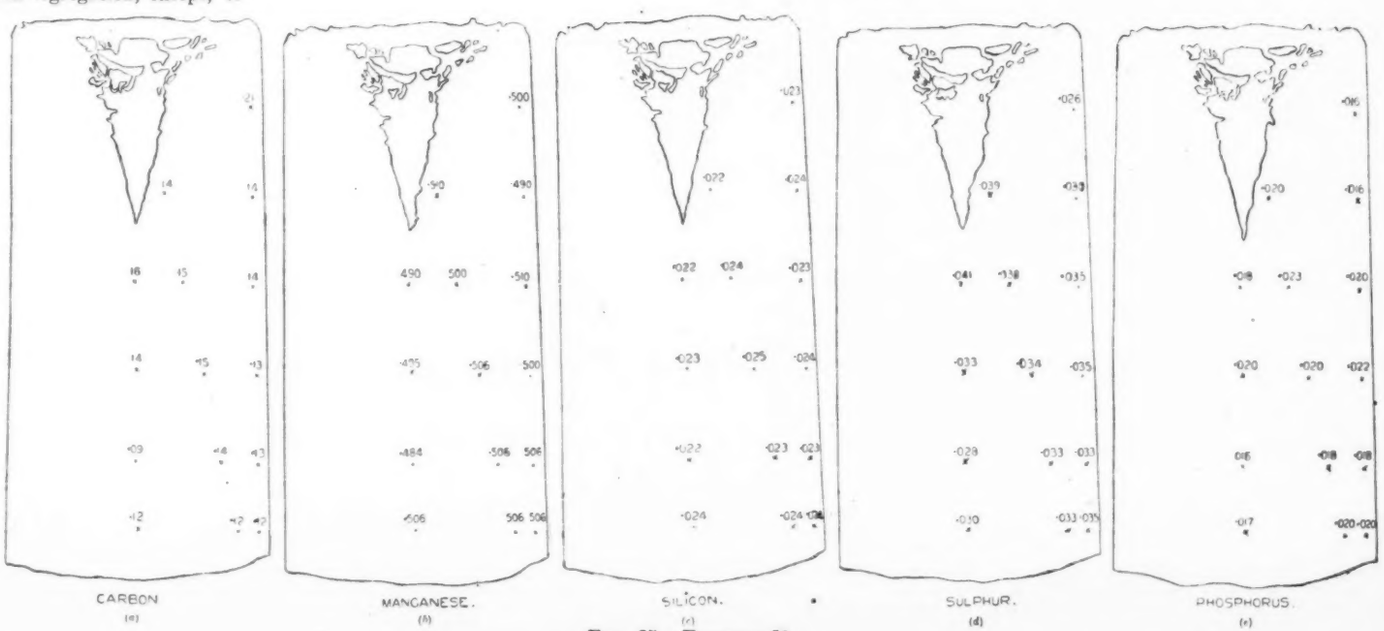


FIG. 25.—EXAMPLE 31.

quite as pronounced as in piping steels, and are intersected here and there by blowholes into which rising segregate appears to have flowed. Fig. 22 (*g*) shows an example of one of these at about half-size. Cavities are also to be seen in the head of the ingot apparently containing rich segregate, which appears to have welled up into them. This effect may have been caused by the liberation of gases in parts nearer the centre where the last portions to freeze would be situated.

Example 29; *Basic Free-Cutting Steel Ingot.*—This is an ingot teemed from a 50-ton basic open-hearth cast having specially high sulphur and phosphorus contents. The analyses of the tapping slag and metal were as follows:—Metal: Carbon, 0.04; manganese, 0.20; sulphur, 0.034; phosphorus, 0.046 per cent. Slag: SiO_2 = 8.0; P_2O_5 = 11.5; CaO = 39.1; Fe = 15.8 per cent. Additions made to the furnace consisted of 12 cwts. of pig-iron and 4 cwts. of spiegel; 7¼ cwts. of 75 per cent. ferro-manganese, 2 cwts. of silicon-manganese (20/70), and 150 lbs. of sulphur and 450 lbs. of ferro-phosphorus were added to the ladle.

The pit sample analysis was as follows:—Carbon, 0.12; manganese, 0.66; silicon, 0.03; sulphur, 0.113; phosphorus, 0.098 per cent.

As regards the temperature at the finishing of the charge, the following data are available: Furnace, 1,620 deg. C.; launder stream 1,635 deg. C., and casting stream 1,575 to 1,570 deg. C. (corrected). The speed of casting was at the rate of 41 cwts. per minute.

This ingot is of interest because, although the silicon content is very low, and no additions of aluminium are made, yet the ingot shows the typical structure and features of ingots of "killed" steel.

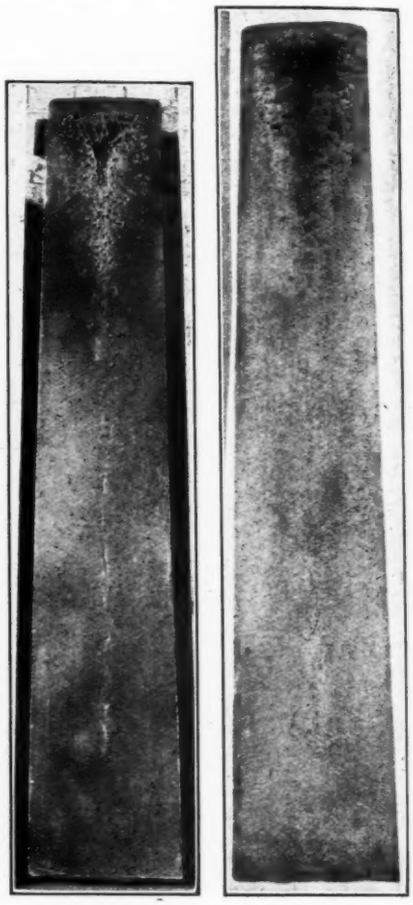
The evolution of gases, typical of low-silicon or "unkilled" steel, is prevented by the high content of sulphur. This sulphur acts as a powerful deoxidising agent. In Figs. 23, *a* to *d*, will be found the results of analyses, and a sulphur print appears in Fig. 23 (*e*).

It will be noted that the ingot displays no blowholes, the major segregation is confined to the feeder-head, and the minor segregation in the body of the ingot is of the same order as in the "solid" ingots of the First Report. For so high a sulphur and phosphorus content, the steel shows a marked degree of uniformity of composition. The pool of segregate below the

Fig. 23 (*e*).—Sulphur Print. Example 29.

Fig. 24 (*g*).—Macro-Etching. Example 30.

Fig. 25 (*g*).—Macro-Etching. Example 31.



(*f*) Polished Section. (*g*) Macro-etching.

Fig. 26.—Example 32.

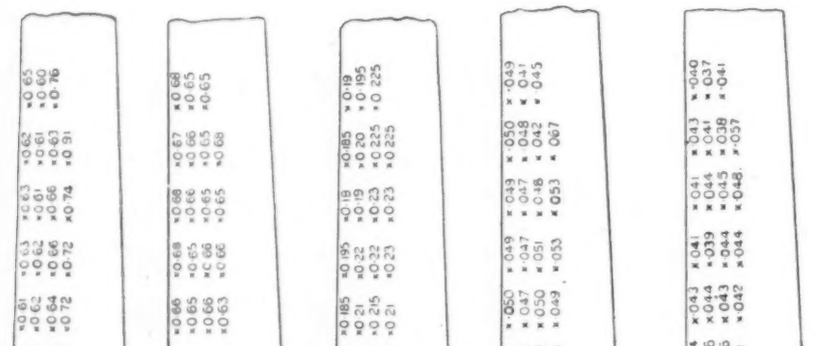


Fig. 26.—Example 32.

head cavity is of interest, having the following composition:—Carbon, 0.31; manganese, 0.71; sulphur, 0.249; phosphorus, 0.239 per cent.

Example 30; *Plate-Steel Ingot.*—This plate-steel ingot was cast in mould L (Fig. 6) from acid open-hearth steel. The analysis of the cast was as follows:—Carbon, 0.19; manganese, 0.51; silicon, 0.075; sulphur, 0.040; phosphorus, 0.042 per cent.

The analyses of the slags during the conduct of the charge were as follows:—

Time.	SiO_2. Per cent.	FeO. Per cent.	MnO. Per cent.	CaO. Per cent.
Melted	39.8	42.19	12.83	2.1
After lime ..	50.5	24.05	18.23	3.8
Boiling	50.0	21.82	19.16	5.7
11 a.m.	36.6	41.83	14.88	3.4
11.30 a.m. ..	51.7	27.86	13.02	3.2
12.0 noon	59.3	21.60	12.09	3.7
12.30 p.m. ..	49.4	28.44	14.60	4.3
Final (tapping)	51.8	27.43	14.14	3.3

The analyses are charted in Figs. 24, *a* to *e*, and a nitric etching print will be found in Fig. 24 (*g*). The ingot formed part of a 55½-ton cast. The tapping temperature was 1,660 deg. C.; ferro-manganese and silicon-manganese were added to the ladle, and a 1-in. nozzle was used.

The steel is intermediate between the open steel ingots shown in Examples 25, 26, and 27, and the piping steel described in the First Report. The characteristic features of this ingot are:—(1) An outside skin of solid metal. (2) A series of blow-holes underneath the skin. They vary in length, but increase in amount and dimensions towards the top end. These small blowholes grow out from the ingot wall almost, but not exactly, at right-angles, having a slight upward direction similar to the growth of chill crystals in piping steel. (3) The remaining surface of the ingot resembles closely that of piping steel, as described in the First Report, namely:—(*a*) A pipe at the top end. (*b*) V-segregates extending from the bottom of the pipe down the centre of the ingot. (*c*) Cone segregates, having the base at the bottom end.

This ingot is typical of the class of steel used for boiler-plates, the bottom end being used for that purpose; a portion of the top is used for ship-plates.

Example 31; *Plate-Steel Ingot.*—This ingot was cast in mould L, Fig. 6. The analysis of the cast was:—Carbon, 0.13; manganese, 0.50; sulphur, 0.033; phosphorus, 0.014 per cent. A little aluminium may have been added during teeming. Charts of the analyses of the ingot will be found in Figs 25, *a* to *e*, and Fig. 25, *g* is a nitric etching print. This steel is of the same class as Example 30. The characteristic features are:—(1) An outside skin of solid metal. (2) A series of blowholes underneath the skin, which, like those in Example 30, increase in amount and length as they approach the top of the ingot. They also extend in a direction similar to chill crystals in piping steel. (3) The remaining section of the ingot is similar to that observed in piping steel: (*a*) A central pipe. In this case the surface of the pipe contains a dark etching material, but no reason can be assigned for its presence; (*b*) a very slight trace of central segregation extending from the bottom of the pipe; the usual V-segregates are not pronounced: (*c*) a trace of the cone segregate only noticeable near the centre, but disappearing before the central pipe and the bottom end are reached.

Example 32; *Acid Siemens Steel Ingot.*—This ingot, cast many years ago, is included as representing early practice. It was cast from the bottom in an octagonal chill mould tapering from 14¾ in. across the flats at the bottom to 10¼ in. across the flats at the top. The mould was close-topped, and for the greater part of its length was 3 in. thick (see mould B, Fig. 2). The total weight of the finished ingot was 23 cwts., so that for a comparison of its degree of segregation it is similar to Example 2, described in the First Report. Analyses are shown in Figs. 26, *a* to *e*, and a polished section and nitric etching print in Figs. 26, *f* and *g*.

The major portion of the cavity was contained in a space within a foot of the top of the ingot, but numerous small cavities were found below this, and were even present along the axis of the ingot to within a height of 12 in. from the bottom. The print shows the greater part of the segregation to exist at the centre line of the ingot in the top 15 in., just below the major portion of the cavity. This disposition of the segregation is confirmed by the analysis, which shows very little variation, except where indicated by the darkly coloured portion of the sulphur print mentioned above.

Compared with Example 2 in the First Report, it will be seen that the two ingots behave very much alike as far as the layout of the segregates is concerned. The main points of difference are as follow:—(1) The lower central zone of relatively pure material is not so marked in Example 32. (2) The region of maximum segregate is drawn out over a long length of the axis of the ingot near the cavity at the top in Example 32, whereas in Example 2 the segregate has collected in a more or less hemispherical formation bordering on the cavity. (3) There is a tendency for the carbon content in Example 32 to increase with the height in the ingot. This tendency is not apparent in Example 2. (4) The analyses for silicon result in slightly lower values on the outside portions of Example 32. This phenomenon is not indicated by the analyses on Example 2.

TABLE IX.—*Range of Composition in each of the Representative Ingots as obtained by Analyses of Drilled Samples at the Seven Standard Positions.*

In preparing this table, the data for position *E* have been excluded in order to be comparable with the results given in the First Report.
The figure "range per cent." for each ingot and element is expressed as a percentage of the amount of the element as ascertained by analysis of the corresponding test ingot.

Example.	Weight of ingot.		Carbon.				Manganese.				Silicon.				Sulphur.				Phosphorus.			
			Test Ingot.	Max.	Min.	Range. Per cent.	Test Ingot.	Max.	Min.	Range. Per cent.	Test Ingot.	Max.	Min.	Range. Per cent.	Test Ingot.	Max.	Min.	Range Per cent.	Test Ingot.	Max.	Min.	Range Per cent.
	Tons	Cwts.																				
24	3	1	0.064	0.109	0.061	75	0.35	0.385	0.368	5.0	0.012	0.118	0.008	917.0	0.039	0.070	0.018	133	0.010	0.013	0.006	70
25	6	15	0.10	0.180	0.115	65	0.49	0.496	0.475	4.0	0.012	0.016	0.004	100.0	0.037	0.065	0.032	89	0.036	0.050	0.030	56
26	7	15	0.14	0.231	0.140	65	0.52	0.578	0.558	4.0	0.024	0.010	Trace	42.0	0.039	0.058	0.020	97	0.024	0.035	0.017	75
27	6	15	0.13	0.190	0.111	61	0.48	0.470	0.450	4.0	0.02	0.018	0.010	40.0	0.039	0.051	0.024	69	0.024	0.038	0.021	71
28	8	0	0.15	0.23	0.16	47	0.49	0.53	0.50	6.0	—	—	—	—	0.059	0.078	0.048	51	0.061	0.078	0.053	41
29	3	6	0.12	0.14	0.10	33	0.66	0.65	0.64	1.5	0.03	—	—	—	0.113	0.112	0.084	25	0.098	0.108	0.067	42
30	7	0	0.19	0.21	0.15	32	0.51	0.522	0.506	3.0	0.075	0.083	0.061	29.0	0.041	0.047	0.032	36	0.042	0.055	0.036	45
31	7	0	0.13	0.16	0.10	46	0.50	0.506	0.490	3.0	0.024	0.025	0.022	12.5	0.033	0.041	0.029	36	0.020	0.023	0.016	35

General Observations on Non-Piping or Semi-Killed Steels.

Table IX (XXIV in the Report) shows the percentage ranges of composition for the various elements in each of the ingots studied, and is useful for comparison purposes.

Except in the case of silicon, the magnitude of the segregation phenomenon for the various elements of the same order is the same as is found in the piping steels. In the case of Examples 24, 25, and 27, the silicon content shows very large differences throughout the ingot, of a magnitude which is considerably greater than was observed in any of the ingots dealt with in the First Report. In Example 24, the large value for silicon found near the bottom of the ingot may or may not be entirely due to segregation, but, as has been previously mentioned, the condition of the bottom plates may have played some part. In Examples 25 and 27, however, the silicon content near the bottom is not excessive, and the maximum figures are found at a part of the ingot well removed from the base.

As to the general distribution of the elements, there is, as in piping steels, a concentration of the impurities (excepting silicon) in the upper portions of the ingot. There is, however, little indication of negative segregation of carbon, sulphur, and phosphorus in the lower central portion of the ingot, except in the case of Example 29, which behaves exactly like a "killed" steel in virtue of its high sulphur content. There is also a zone of low carbon content in Example 27. All the ingots show evidence of an increased silicon content in the lower middle portion of the ingot, to an even more marked degree than did the ingots dealt with in the First Report. All the ingots reveal V-segregates near the central axis, but they are not so distinct as they are in the piping steels. The non-piping steel does not show ∧-segregate formation; the semi-killed ingots, however, all show this formation. In Example 26 this ∧-segregate is confined to a very narrow zone, whereas in Examples 25 and 27, which were cast on the cold side, it covers a much wider area, or, rather, there appear to be three or more separate inverted cones of segregate in these two ingots.

Attention might again be drawn to the relative purity of the outer layer of the ingots cast from steel in a wild or semi-killed condition.

The Report concludes with an Interim Report on the researches at Sheffield University by Professor Desch, which includes a determination of the changes of density in steel in the neighbourhood of the melting point, and also of the viscosity of molten steel; and at Glasgow Technical College by Professor J. H. Andrew, D.Sc., on the freezing and melting ranges of the various types of steel dealt with in the First and Second Reports, including experiments to gain information with respect to the formation and possible solubility of sulphide segregates in steel.

A final Section is devoted to a continuation of the Bibliography presented in the First Report.

British Facilities for Foundry Training.

(*Continued from page* 58.)

for heat-treatment and elmentary furnace work, the equipment includes muffle furnaces, which are heated by Mond gas, generated at the university, and a nest of crucible furnaces.

In the pyrometer laboratory are the instruments for the various heat-treatment furnaces, as also a master pyrometer upon which the whole of the furnaces can be instantly read. A considerable amount of research work is being carried out with the electrical control of furnace temperatures, the control being operated through a pilot furnace by which means the temperature within the working furnace can be maintained constant within three degrees up or down, obviously this control is only possible with a closed furnace.

Ample provision is made for research work in well-equipped laboratories. We need not, however, deal at any length with this side of the subject.

In the museum, which is contained in the galleries above the laboratories, are to be seen some excellent examples of the founder's art.

From the foregoing it would seem that at Birmingham University there is not an unbridgeable gap between the existing facilities and those which would be required for the efficient training of the students upon whom will depend the conduct and advancement of future foundry practice.

Trade Talk.

MESSRS. WM. GRAY & COMPANY, LIMITED, West Hartlepool, have received an order from Continental shipowners for a steamer of 8,500 tons.

MESSRS. ROBERT STEPHENSON & COMPANY, LIMITED, Darlington, have been commissioned privately to build a replica of Stephenson's famous "Rocket" engine.

THE SVENSKA LLOYD SHIPPING COMPANY, of Gothenburg, has ordered two vessels of 4,300 tons each from Messrs. Swan, Hunter & Wigham Richardson, Limited.

MEMBERS OF THE Manchester Association of Engineers paid a visit last week to the works of Messrs. Beyer, Peacock & Company, Limited, Gorton, Manchester.

SHEFFIELD STEEL PRODUCTS, LIMITED, have acquired the share capital and assets of the J. L. Morrison Company, Limited, makers of wire-stitching machinery, Stockport.

THE STEAMER "POLCIRKELN," from Narvik, with a cargo of iron ore for Messrs. David Colville & Sons, Ltd., made a record discharge at Ardrossan, unloading 3,100 tons in 14½ hours.

ALTOGETHER 43 VESSELS of 162,513 gross tons were launched from the Tyne in the past six months, an increase of 21 vessels and 64,076 tons on the corresponding period last year.

AN EXTRAORDINARY GENERAL MEETING of Messrs. Baldwins, Limited, held for the purpose of considering the modifications to the pending scheme of reconstruction which have been made to meet the objections of the 7½ per cent. debenture holders, has assented to the modified scheme.

TWO HUNDRED Conservative Members of Parliament have signed a memorial to the Prime Minister asking that there should be an immediate application of the safeguarding principle to the iron and steel trades. The Prime Minister has informed a deputation that no steps will be taken before the next General Election.

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have secured a contract for the construction of a large number of superheated locomotive boilers and other locomotive details for the Indian State Railways. The work will be carried out at the company's Scotswood Works, Newcastle-on-Tyne.

THE GRAND COUNCIL OF THE FEDERATION OF BRITISH INDUSTRIES have expressed themselves as wholeheartedly in agreement with Lord Melchett's "peace in industry" movement, and have appointed a committee, representative of all the industrial groups of the Federation, to investigate the proposals and the various questions involved.

THE LONDON AND NORTH-EASTERN RAILWAY are to abandon, as from October 31 next, the East and West Rosedale branch railways, which extend from Battersby Junction, where they connect with the North Yorkshire and Cleveland branch, to Blakey Junction. The railways were constructed primarily for the conveyance of iron ore from the mines in the district to the blast-furnaces in Cleveland. The mines are now worked out.

THE DIRECTORS OF Messrs. William Beardmore & Company, Limited, have initiated steps intended to reduce production costs and to place the present volume of business on a paying basis. No cut in the men's wages is involved in the new policy, but reductions are to be made in management, staff and the services at the Parkhead works. The expert committee appointed a year ago to inquire into the company's affairs has not yet reported, but hopes to submit a complete capital reorganisation scheme in the near future.

ON JULY 19, at the invitation of the Chairman (Sir Robert Hadfield, Bt.) and directors, a large party of visitors journeyed to the East Hecla Works of Messrs. Hadfields, Ltd., Sheffield, on the occasion of a visit paid thereto by the President of the Institution of Civil Engineers (Mr. E. F. C. Trench, C.B.E.) and the Worshipful Company of Blacksmiths. In addition to Mr. Trench the list of guests included Mr. R. W. Morrison (Prime Warden of the Worshipful Company of Blacksmiths), the Rt. Hon. John Hodge, M.P., Mr. L. H. Savile (Chief Civil Engineer, Admiralty), Engineer Rear-Admiral R. W. Skelton (Chief Engineer, Admiralty), Rear-Admiral H. W. Hope (Ordnance Committee, Admiralty), Sir Henry Fowler (Chief Mechanical Engineer, L.M. & S. Railway), Sir Frederick Becker, Sir Henry Coward, Sir Martin Hall, Bt., Mr. J. Miller (Chief Engineer, L. & N.E. Railway), Mr. A. Newlands (Chief Engineer, L.M. & S. Railway), Mr. W. D. Dawes (Managing Director, Anglo-Argentine Tramways Company, Limited), Mr. Norton Griffiths (Managing Director, Norton Griffiths & Company, Limited, London), Captain Bowden (Mechanical Engineer, South African Railways), Alderman Bowes (President, Municipal Tramways Association), Professor Louis (Chairman, North-Eastern Section of Civil Engineers), and Mr. J. H. Chapman (President, Sheffield Chamber of Commerce). After a tour of the works the visitors were entertained at lunch.

Reports and Dividends.

Mather & Platt, Limited.—Interim dividend of 5 per cent., tax free.

Howard & Bullough, Limited.—Usual quarterly dividend of 6d. per share.

Midland Iron Company, Limited.—Loss on trading of £5,584, making a total deficit of £15,066.

Grovesend Steel & Tinplate Company, Limited.—Net profit, after providing for debenture interest, £63,608; brought in, £82,255; reserve for depreciation and renewals, £48,641; dividend of 2s. per share, less tax, on the ordinary shares; carried forward, £79,613.

Richardsons, Westgarth & Company, Limited.—Profit, £31,905; interest on debenture stock, £1,152; directors' fees, £2,500; depreciation, £10,000; preference dividend (provided from reserve), £21,000; ordinary dividend, 5 per cent.; carried forward, £3,317.

D. & W. Henderson & Company, Limited.—Balance at credit of profit and loss account, £2,578; transferred from preference dividend reserve, £15,000; preference dividend for half-year, £7,500; 3 per cent. depreciation on buildings and 10 per cent. on machinery, £7,130; carried forward, £2,948.

Zinc Corporation, Limited.—Profit, £259,278; balance of appropriations for mine development and new plant at December, 1926, now written back, £89,875; allocation for mine development and new plant, £100,000; participating dividend of 2s. 6d. per share, making 4s. on the ordinary shares and 8s. on the preference; carried forward, £42,103.

Bengal Iron Company, Limited.—Profit, including £223,975 due from the Indian Iron and Steel Company, Limited, £465,169; brought forward, £7,065; depreciation and colliery sinking fund, £75,811; debenture interest, £66,410; debenture redemption sinking fund reserve, £23,589; payable to Indian Iron & Steel Company, Limited, under 1925 agreement, £13,428; written off debenture discount account, £4,550; special depreciation, repairs, etc., £65,000; two years' preference dividends, £75,000; dividend on ordinary shares of 8 per cent. for year, £126,000; carried forward, £22,444.

British Metallising, Limited.—The statutory report states that the number of shares allotted is 1,000,000, of which 300,000 have been allotted as fully paid up in consideration of transfer of assets of Precious Metals Industries. Upon each of remaining 700,000 shares 2s. has been paid in cash. Total amount received by company in respect of shares issued wholly for cash is £70,000. Payments are as follow:—Preliminary expenses, £2,578; machinery and plant, £693; expenditure in connection with new patents, £262; excess of revenue expenditure over income, £2,439; cash, £64,025. Preliminary expenses are estimated at £2,700.

Personal.

LIEUT.-COMMANDER E. R. MICKLEN has been appointed a special director of Messrs. Vickers-Armstrongs, Limited, and general manager of the Elswick works.

MR. D. OWEN EVANS has relinquished his position as secretary of the Mond Nickel Company, Limited, and has been appointed organising administrator of the company and its subsidiary undertakings.

MR. J. D. BELL, of Messrs. James Campbell & Son, Limited, merchants, Brisbane, president of the Australian Hardware Merchants' Federation, who is on a visit to this country, is making the London Iron & Steel Exchange, Imrie House, King William Street, London, E.C.4, his business headquarters while here. Business communications should, therefore, be sent to him at this address. Mr. Bell holds prominent views as to the advisability of a better understanding between the distributors in Australia and British hardware manufacturers, and while in this country he will endeavour to promote closer working on lines which were approved by his Federation before he left Australia.

Contracts Open.

Skelmanthorpe, July 31.—Supplying and laying approximately 640 yds. of 5-in. cast-iron water pipe, with valves, etc., for the Urban District Council. Mr. J. Haigh, clerk, Council Offices, Skelmanthorpe.

Thorne, August 2.—Supplying and laying of about 400 yds. of 10-in. and 8-in. cast-iron pipes, with necessary valves, specials, etc., for the Thorne and District Water Company. Messrs. Fairbank & Son, engineers to the company, Tudor House, Stonegate, York. (Fee £2 2s., returnable.)

Book Review.

An Introduction to the Metallurgy of Iron and Steel, by H. M. Boylston, B.S. Published by Messrs. Chapman & Hall, Limited, 11, Henrietta Street, London, W.C.2. Price 25s.

In this book the author has furnished us with an intensely interesting and complete survey of the metallurgy of iron and steel, written in an easily readable form, the value of which is greatly enhanced by the numerous diagrams and illustrations which it contains. It is evident throughout, however, that the author is writing primarily of American practice, and this naturally renders some sections of the work unsuitable for general text book purposes in this country, except where it is used as supplementary to other books of British origin. This applies particularly to the early chapters dealing with the production of pig-iron, for recent experiences have emphasised to us the marked differences between the nature of this product at home and in the States, differences which find their origin not only in the chemical analysis of the raw products of the blast furnace, but also in the differing furnace practices prevailing on either side of the Atlantic. These differences are carried forward, and are still to be found in the various steel-making processes described.

Throughout there is a wealth of detail in the book which renders it a very valuable addition to the available works of reference; in this connection special mention might be made of the sections dealing with steel-making furnaces of both the ordinary and electric types. The author has also very wisely devoted considerable space to the consideration of ingots, with special reference to the defects from which they suffer, and to the effects of these on the after treatment of the ingot. This treatment, including both hot and cold working, is dealt with in some detail, and leads up to the last part of the book which deals with the metallography of iron and steel. In this section is an admirable survey of the influence of impurities and special elements, with full reference to alloy steels. The latter, of course, cannot be but more than an introduction to the subject, but is undoubtedly a very helpful and concise summary.

On looking through the lists of references, it is found that many British authors are mentioned in connection with the various sections of the subjects treated, but these perhaps are not numerous enough to make the book complete for the British worker. Again, the expression of temperature in degrees Fahrenheit, and of stress in pounds per square inch, together with American standard specifications, remind the reader perhaps too often of the source of origin of the book.

We are certain, however, that this is a book of outstanding merit, not only for its wealth of detail, but also for its easy literary style, which renders it a pleasure to read, and a valuable source of instruction and work of reference.

A. B. E.

Mr. Frank Russell Injured.

We regret to announce that Mr. Frank Russell, F.G.S., the managing director of the General Refractory Company, has been injured as the result of a motor-car accident. We understand that Mr. Russell himself is not too seriously injured, but that some of his family and friends have suffered severely; one indeed, Mr. Miles, of Leeds, has since died. On behalf of Mr. Russell's innumerable friends in the foundry industry, we tender our sincere sympathy to him during the anxious period through which he and his family are now passing.

Staveley Ironworks on Full Time.—After being on short time for about nine months, the ironworkers employed by the Staveley Coal and Iron Company, Notts., have just resumed practically full-time working at the new and old foundries in all departments, owing to the management having booked some fairly substantial orders. The men principally affected are the straight cast-iron pipe moulders, especially at the old works, where the depression has been so acute that many have averaged only about two days a week, and some not that, since the slump set in towards the end of last year. On the other hand, loose pattern moulders have experienced better times during the depressed conditions in the other departments, when the reverse is often the case.

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Approximate Analyses of SHOTTS PIG IRON

FOUNDRY, FORGE AND CYLINDER QUALITIES.

	Iron. %	Graphitic Carbon. %	Combined Carbon. %	Silicon. %	Sulphur. %	Phos. %	Mang. %
No. 1	91.38	3.30	.25	3.25	.02	.70	1.10
No. 3 Soft	91.67	3.40	.20	2.90	.03	.70	1.10
No. 3 Medium	91.95	3.25	.35	2.60	.05	.70	1.10
No. 3 Hard	92.49	3.00	.45	2.30	.06	.70	1.00
No. 4 Soft	93.03	2.90	.50	1.80	.07	.70	1.00
No. 4 Hard	93.50	2.75	.65	1.40	.10	.70	.90
Cylinder Iron	93.77	2.60	.65	1.50	.08	.70	.70
Mottled	93.95	2.00	1.50	.90	.15	.70	.80
White..	94.35	.60	2.80	.55	.30	.70	.70

Compositions other than the above regularly made to Customer's requirements.

In addition to PIG IRON, we are Producers of the following :—

Blast Furnace Pitch, Creosote, and Sulphate of Ammonia.
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Slag for Ballasting and Road Making broken to sizes to suit purchasers.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The Cleveland iron market during the current month has undergone little change, either in the volume of business transacted or in the promise of future recovery, conditions on the whole remaining, if possible, quieter and almost entirely devoid of interest in the matter of buying and selling. Very obviously, the present slackness is accentuated by the holiday influences prevailing at this period of the year, the majority of consuming works invariably suspending deliveries of pig-iron in the North and elsewhere until operations are resumed, usually in August, but sometimes later in the autumn. In the meantime the restricted outputs at Tees-side furnaces are kept well within the limits of current requirements, and consequently no excessive accumulations of stocks are anticipated. Shipments for the month so far show little appreciable difference in tonnage as compared with the figures for the corresponding period in June, foreign transactions now being reduced to almost retail proportions. Despite the numerous difficulties of the position, Cleveland ironmasters decline to reconsider the present high level of quotations, which remain unchanged as follow:—No. 1 Cleveland foundry iron, 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; No. 4 forge, 64s. 6d. per ton.

Competition in the market for East Coast hematite has now become more acute, makers cutting prices keenly for fresh orders. Hematite quotations are, in fact, most irregular, some sellers asking up to 70s. per ton, while others quote 68s. 6d. for mixed numbers, with No. 1 quality at 6d. per ton premium. On the North-West Coast also prices are weaker. Bessemer mixed numbers now being quoted down to 68s. 6d. per ton at works.

LANCASHIRE.—Purchases of foundry pig in the local markets during the week have been confined within very restricted limits, conditions quite likely to continue until the season has further advanced and production is resumed at the works. Prices consequently are practically unaltered, both Derbyshire and Staffordshire being on offer at from 68s. to 68s. 6d. per ton, delivered Manchester or equal distance, and Cleveland at round 79s., with Scottish brands ranging from 87s. 6d. to 90s. per ton, according to quantity and make.

THE MIDLANDS.—Consumers of foundry pig in the Black Country districts are temporarily out of the market, and business everywhere is slack. In the meantime prices are maintained. Derbyshire No. 3 is 60s. to 61s. at furnaces, and Northants. 55s. to 56s., f.o.t., while North Staffordshire No. 3 commands the same figure as Derbyshire.

SCOTLAND.—With the annual holidays now in full swing, there is practically no business to report this week. Prices are unchanged on the basis of 70s. 6d. for No. 3 foundry, f.o.t. furnaces. The N.L.C.A. founders in the Falkirk district have resumed work, but business is exceedingly quiet and they are buying very little pig-iron, as they have still considerable quantities to take against old contracts, which are in arrears.

Finished Iron.

Conditions in the manufacturing branches of the iron trade are subject at the moment to seasonal influences, and very few fresh orders are reported in the markets. In the South Staffordshire area the fixed price of £12 for marked bars is unchanged, but makers of this grade of iron are only moderately occupied. There is still much slackness in the call for crown iron, and none of the mills in this area or in other districts can keep going except intermittently. Prices are being cut for any good lines which may be offering, and quotations vary from £9 to £9 15s., delivered this district. In regard to nut and bolt iron, the Staffordshire figure for this grade is anything from £8 12s. 6d., but foreign offers of No. 3 are at £6 12s. 6d., delivered Darlaston district works.

Steel.

Very few developments worth recording can be noted in the general aspect of the steel industry, and at Sheffield the volume of business is only limited. Basic billets are in rather better demand than acid. Prices show no change upon last week. Production of open-hearth steel has been further reduced, and crucible steel output is on a smaller scale. The demand for non-corrosive steel shows expansion. As regards finished material, some of the works report that specifications for structural steel are coming through somewhat better, and in the aggregate represent a larger tonnage than of late. Until recently there was a certain amount of activity in the Continental department, but the inquiry since for all classes of steel has noticeably diminished. Tinplate makers generally are in a comfortable position, but if trade does not improve they will probably reduce the output to prevent values falling away. In the meantime quotations rule:—Coke tinplates, 18s. 3d. to 18s. 4½d. basis for approved specifications, net cash, f.o.b. Wales.

Scrap.

With most of the consuming industries temporarily idle, demand for scrap metal for foundry use is naturally limited in volume, but with, so far, little variation in prices. At Middlesbrough machinery cast-iron scrap is still quoted 66s. per ton delivered works, while in the Midlands similar quality commands from 65s. to 67s. 6d. per ton. In the Black Country, although the majority of foundries are not very busy, dealers have no difficulty in selling the whole of their supplies of heavy cast-iron machinery scrap, in cupola sizes, at round about 65s. delivered, and light cast-iron scrap at 52s. 6d. delivered.

Metals.

Copper.—Movements in the market for warrant copper during the current week confirm the recent steadiness of values of the metal, favoured largely by the American statistics for June, which revealed a decrease of 7,500 tons in stocks of refined and an increase of nearly 10,000 tons in those of blister. Many of the larger consumers who had been holding back in case the June figures should disclose a heavy accumulation of metal, will now, presumably, re-enter the market, and a steady appreciation of values is therefore by no means an impossibility.

Closing quotations are :—

Cash.—Thursday, £63 to £63 1s. 3d.; Friday, £62 17s. 6d. to £62 18s. 9d.; Monday, £62 16s. 3d. to £62 18s. 9d.; Tuesday, £62 16s. 3d. to £62 17s. 6d.; Wednesday, £62 18s. 9d. to £63.

Three Months.—Thursday, £63 6s. 3d. to £63 7s. 6d.; Friday, £63 5s. to £63 6s. 3d.; Monday, £63 3s. 9d. to £63 5s.; Tuesday, £63 3s. 9d. to £63 5s.; Wednesday, £63 6s. 3d. to £63 7s. 6d.

Tin.—Following a lengthy period of depression, during which values declined very near the £200 mark, the market for standard tin gives signs of impending improvement, having at last week's close recovered to the extent of £9 on the previous fortnight's levels. This improvement appears likely to continue, for the world consumption of tin tends to increase and to check any growth in stocks. Thus in the first six months of this year consumption was 75,110 tons, and the supplies 75,637 tons. Stocks at the end of June last were 6,462 tons, and although about 1,300 tons higher than the same date in 1927, were 2,499 tons below 1926.

Official closing prics :—

Cash.—Thursday, £218 to £218 5s.; Friday, £215 12s. 6d. to £215 15s.; Monday, £216 to £216 2s. 6d.; Tuesday, £217 10s. to £217 12s. 6d.; Wednesday, £218 10s. to £218 15s.

Three Months.—Thursday, £213 10s. to £213 15s.; Friday, £212 to £212 5s.; Monday, £213 to £213 2s. 6d.; Tuesday, £214 10s. to £214 12s. 6d.; Wednesday, £215 7s. 6d. to £215 12s. 6d.

Spelter.—The market for ordinary spelter continues dull and uneventful, with prices on the whole inclined to a weaker tendency. The galvanising trades are moderately active, but for the moment are purchasing supplies somewhat cautiously, and this, together with the settlement of the Antwerp dock strike, which has released greater supplies of prompt metal, is probably responsible for the temporary weakness of the market.

Daily quotations are :—

Ordinary.—Thursday, £24 12s. 6d.; Friday, £24 12s. 6d.; Monday, £24 12s. 6d.; Tuesday, £24 13s. 9d.; Wednesday, £24 15s.

Lead.—Demand, both for English and foreign soft pig, continues fairly satisfactory, with values steady on the whole. Current quotations are, of course, very low, but until the market shows a much more stable tendency, fluctuations are likely to be within narrow limits and any marked increase is improbable. During the first half of the year production has decreased by some 8,000 tons, but even at that it cannot be said that supplies are being too readily taken up.

Closing prices :—

Soft Foreign Prompt.—Thursday, £20 13s. 9d.; Friday, £20 15s.; Monday, £20 16s. 3d.; Tuesday, £20 16s. 3d.; Wednesday, £20 17s. 6d.

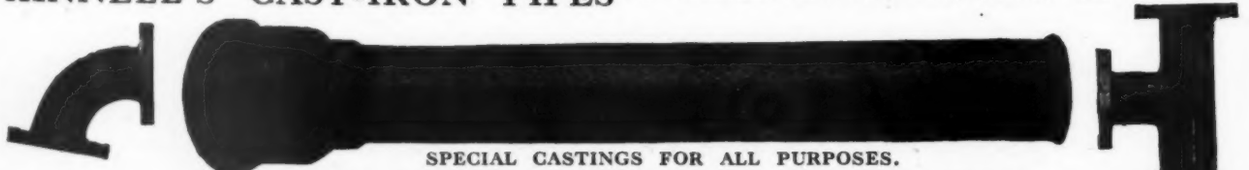
Catalogues Received.

Foundry Coke.—Accompanying a circular letter of an extremely informative character from the Consett Iron Company, Limited, of Consett, Co. Durham, there is an enclosure consisting of a 4-page leaflet. This has been prepared by Mr. R. Bulmer, their chief chemist, and contains reliable information which ought to be in the possession of every person controlling coke-fired furnace operations. It is devoid of advertising matter, and is calculated to whet the thirst for additional technical information which firms of the calibre of Consett will most willingly supply.

Aluminium.—The British Aluminium Company, Limited, of Adelaide House, King William Street, London, E.C.4, have sent us a copy of their latest issue of Aluminium Facts and Figures. Of the 52 subjects listed in the index, no less than 19 are of direct interest to foundrymen. Certain sections, especially those dealing with such subjects as melting, moulding, and casting, are, we suspect, written under the supervision of Captain Mortimer, who more than anyone has the confidence of the practical founder in Great Britain, because of his sympathy with their difficulties and his concise and clear advise for their amelioration. We insist that any founder finding himself favoured with a copy of this book can indeed count himself very fortunate.

Ilkeston Moulder Injured.—Charles Rowland, aged 17, was admitted to the Nottingham General Hospital recently suffering from an abdominal injury. Rowland, who is a moulder employed at the Stanton Ironworks, was lifting an iron door when he collapsed.

KINNELL'S CAST-IRON PIPES & CONNECTIONS FOR GAS, WATER AND STEAM.



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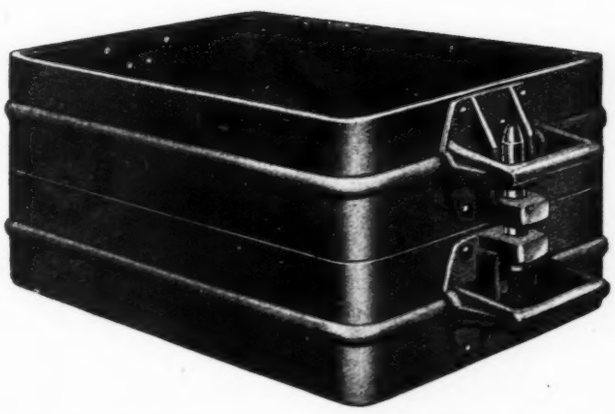

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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	62	18	9
Three months	63	6	3
Electrolytic	68	15	0
Tough	65	10	0
Best selected	65	10	0
Sheets	94	0	0
India	76	15	0
Wire bars	69	5	0
Do. August	69	5	0
Do. September	69	5	0
Ingot bars	69	5	0
H.C. Wire rods	73	5	0
Off. av. cash, June	63	13	11½
Do. 3 mths., June	63	14	0½
Do., Sttlmnt., June	63	14	0½
Do., Electro, June	68	19	0½
Do., B.S., June	67	5	10
Aver. spot price, copper, June	63	13	11½
Do., Wire bars, June	69	3	4
Solid drawn tubes			13½d.
Brazed tubes			13½d.
Wire			10d.

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10½d.
Wire	9½d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

		£	s.	d.
Standard cash		218	10	0
Three months		215	7	6
English		216	5	0
Bars		217	5	0
Straits	(Nom.,	220	15	0
Australian	(Nom.)	220	5	0
Eastern		219	15	0
Banca	(Nom.)	221	5	0
Off. av. cash, June		217	17	5⅜
Do., 3 mths., June		215	9	3⅜
Do., Sttlmt., June		217	7	0⅜
Aver. spot, June		217	7	5½

SPELTER.

	£	s.	d.
Ordinary	24	15	0
Remelted	23	10	0
Hard	20	0	0
Electro 99.9	29	5	0
English	25	2	6
India	21	0	0
Zinc dust	33	0	0
Zinc ashes	8	0	0
Off. aver., June	25	10	11 1/6
Aver., spot, June	25	13	3½

LEAD.

	£	s.	d.
Soft foreign ppt.	20	17	6
English	22	0	0
Off. average, June	21	1	11½
Average spot, June	20	19	8½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	33	0	0
Do. V.M. ex whf.	31	10	0
Rods	39	0	0
Boiler plates	29	0	0
Battery plates	30	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	59	10	0
Chinese	39	0	0
Crude	33	10	0

QUICKSILVER.

	£	s.	d.
Quicksilver	20	18	9

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	8	0	0
45/50%	12	5	0
75%	19	0	0
Ferro-vanadium—			
35/40%	14/3 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/3 lb. Mo.		
Ferro-titanium—			
23/25% carbonless	1/2 lb.		
Ferro-phosphorus, 20/25%	£18	0	0
Ferro-tungsten—			
80/85%, c. fr.	1/3 lb.		
Tungsten metal powder—			
98/99%	1/7 lb.		
Ferro-chrome—			
2/4% car.	£30	0	0
4/6% car.	£21	0	0
6/8% car.	£20	10	0
8/10% car.	£20	0	0
Ferro-chrome—			
Max. 2% car.	£33	0	0
Max. 1% car.	£39	0	0
Max. 0.70% car.	£44	0	0
70% carbonless	1/2 lb.		
Nickel—99% cubes or pellets	£175	0	0
Ferro-cobalt	9/- lb.		
Aluminium 98/99%	£100	0	0
Metallic chromium—			
96/98%	2/8 lb.		
Ferro-manganese (net)—			
76/80% loose	£13	15	0
76/80% packed	£14	15	0
76/80% export	£13	10	0
Metallic manganese—			
94/96%, carbonless	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0	2	3
Finished bars, 18% tungsten	£0	2	9

Per lb. net, d/d buyers' works.

Extras—
- Rounds and squares, 3 in. and over — 4d. lb.
- Rounds and squares, under ½ in. to ¼ in. — 3d. lb.
- Do., under ¼ in. to 7/32 in. — 1/- lb.
- Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. — 3d. lb.
- Do., under ⅛ in. × ¼ in. — 1/-lb.
- Bevels of approved sizes and sections — 6d. lb.
- Bars cut to length, 10% extra.

Scrap from high-speed tool steel—
- Scrap pieces — 3d.
- Turnings and swarf — 1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.
South Wales—			
Hvy. steel	3	7	6
Bundled steel and shrngs.	3 2 6 to 3	5	0
Mixed iron and steel	3 0 0 to 3	2	6
Heavy cast iron	3	19	0
Good machinery for foundries	3	2	6
Cleveland—			
Heavy steel	2	14	0
Steel turnings	2	8	6
Cast iron borings	2	3	0
Heavy forge	3	10	0
Bushelled scrap	3	2	6
Cast-iron scrap	3 1 6 to 3	6	0
Lancashire—			
Cast-iron scrap	3	0	0
Hvy. wrought	2	17	6
Steel turnings	2	2	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	52	0	0
Brass	37	0	0
Lead (less usual draft)	18	0	0
Tea lead	16	0	0
Zinc	16	0	0
New aluminium cuttings	68	0	0
Braziery copper	47	0	0
Gunmetal	47	0	0
Hollow pewter	150	0	0
Shaped black pewter	105	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/-
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	69/-
Hematite M/Nos.	68/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	79/-
,, d/d Birm.	85/-
Midlands—	
Staffs. common*	67/6
,, No. 4 forge	57/-
,, No. 3 fdry.	60/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	52/6
,, fdry. No. 3	55/-
Derbyshire forge	59/-
,, fdry. No. 3	60/6
,, basic	60/-
Scotland—	
Foundry No. 1	75/-
,, No. 3	70/-
Hem. M/Nos.	74/-
Sheffield (d/d district)—	
Derby forge	62/6
,, fdry. No. 3	64/6
Lincs. forge	62/6
,, fdry. No. 3	64/6
E.C. hematite	79/-
W.C. hematite	84/-
Lincs. (at furnaces)—	
Forge No. 4	58/-
Foundry No. 3	60/-
Basic	58/6
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	68/-
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	87/6
Glengarnock, No. 3	87/6
Gartsherrie, No. 3	87/6
Monkland, No. 3	87/6
Shotts, No. 3	87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.	9	10	0 to	10	15	0
Nut and bolt iron	8	12	6 to	8	15	0
Hoops				11	10	0
Marked bars (Staffs.) f.o.t.				12	0	0
Gas strip				11	10	0
Bolts and nuts, ¾ in. × 4 in.				15	5	0
Steel—						
Ship plates				8	7	6
Boiler plts.				10	10	0
Chequer plts.				10	12	6
Angles				7	17	6
Tees				8	17	6
Joists				7	17	6
Rounds and squares, 3 in. to 5½ in.				8	17	6
Rounds under 3 in. to ¼ in. (Untested)				7	15	0
				and upwards		
Flats, over 5 in. wide and up				8	7	6
Flats, 5 in. to 1¼ in.				7	17	6
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs.)				10	0	0
Black sheets, 24g.				10	0	0
Galv. cor. shts., 24g.				13	10	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft	6	0	0 to	6	15	0
Billets, hard	7	2	6 to	7	12	6
Sheet bars	6	0	0 to	6	2	6
Tin bars	6	0	0 to	6	2	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2½
Sheet to 10 w.g.	1 3
Wire	1 3½
Rods	1 3
Tubes	1 7½
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.26
No. 2 foundry, Valley	16.75
No. 2 foundry, Birm.	15.50
Basic	17.76
Bessemer	18.76
Malleable	18.76
Grey forge	18.01
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	32.00
O.-h. billets	32.00
O.-h. sheet bars	32.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd., 9 and 10	2.00
Wire nails	2.55
Plain wire	2.40
Barbed wire, galv.	3.20
Tinplates, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham and North.	
,, foundry	14/6 to 15/-
,, furnace	14/- to 14/3
Other Districts, foundry	—
,, ,, furnace (basis)	12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14	box	18/3
,,	28×20	,,	36/6
,,	20×10	,,	27/3
,,	18¾×14	,,	19/-
C.W.	20×14	,,	17/-
,,	28×20	,,	34/-
,,	20×10	,,	22/-
,,	18¾×14	,,	15/9
Terneplates	28×20		34/- per box basis f.o.b.

SWEDISH IRON.

Bars, hammered, £17 10 0 to £18 10 0	
Rolled Ord.	£15 0 0 to £15 10 0
Nail rods	£15 7 6 to £15 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron	£5 15 0 to £6 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas	67½%	50%
Water	63¾%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
July 19 ..	63	0	0	inc.	1/3
,, 20 ..	62	17	6	dec.	2/6
,, 23 ..	62	16	3	,,	1/3
,, 24 ..	62	16	3	No change	
,, 25 ..	62	18	9	inc.	2/6

Electrolytic Copper.

	£	s.	d.		
July 19 ..	68	15	0	No change	
,, 20 ..	68	15	0	,,	,,
,, 23 ..	68	15	0	,,	,,
,, 24 ..	68	15	0	,,	,,
,, 25 ..	68	15	0	,,	,,

Standard Tin (cash).

	£	s.	d.		
July 19 ..	218	0	0	inc.	5/-
,, 20 ..	215	12	6	dec.	47/6
,, 23 ..	216	0	0	inc.	7/6
,, 24 ..	217	10	0	,,	30/-
,, 25 ..	218	10	0	inc.	20/-

Tin (English ingots).

	£	s.	d.		
July 19 ..	215	10	0	inc.	5/-
,, 20 ..	213	10	0	dec.	40/-
,, 23 ..	213	10	0	No change	
,, 24 ..	215	5	0	inc.	35/-
,, 25 ..	216	5	0	inc.	20/-

Zinc Sheets (English)

	£	s.	d.		
July 19 ..	33	0	0	No change	
,, 20 ..	33	0	0	,,	,,
,, 23 ..	33	0	0	,,	,,
,, 24 ..	33	0	0	,,	,,
,, 25 ..	33	0	0	,,	,,

Spelter (ordinary).

	£	s.	d.		
July 19 ..	24	12	6	inc.	1/3
,, 20 ..	24	12	6	No change	
,, 23 ..	24	12	6	,,	,,
,, 24 ..	24	13	9	inc.	1/3
,, 25 ..	24	15	0	inc.	1/3

Lead (English).

	£	s.	d.		
July 19 ..	22	0	0	No change	
,, 20 ..	22	0	0	,,	,,
,, 23 ..	22	0	0	,,	,,
,, 24 ..	22	0	0	,,	,,
,, 25 ..	22	0	0	,,	,,

Exports of Iron Castings in June and the six months 1928, compared with June and the six months 1927.

	June, 1927.	June, 1928.	Six months, 1927.	Six months, 1928.	June, 1927.	June, 1928.	Six months, 1927.	Six months, 1928.
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
To Argentine Republic	76	163	837	869	2,414	7,840	30,102	37,334
,, British South Africa	160	375	1,478	1,905	6,098	12,238	53,028	66,235
,, ,, India	71	132	597	821	2,732	6,557	25,921	36,514
,, Australia	87	69	542	359	6,267	5,243	30,623	25,495
,, New Zealand	188	139	1,198	1,002	9,595	6,992	60,750	49,358
,, Other countries	615	831	4,165	4,642	29,318	41,384	209,783	216,568
Total	1,197	1,709	8,817	9,598	56,424	80,254	410,207	431,504
PIPES AND FITTINGS—CAST—								
To Argentine Republic	618	685	5,529	4,378	5,444	7,931	59,383	46,713
,, British South Africa	372	306	2,789	2,608	5,379	6,079	45,390	42,060
,, ,, India	537	639	3,386	4,916	8,133	8,087	49,719	61,490
,, Straits Settlements and Malay States	1,299	1,210	6,419	7,643	13,572	9,921	64,895	68,315
,, Ceylon	253	110	787	654	2,689	1,126	9,470	7,828
,, Australia	1,251	983	4,882	5,913	14,081	10,473	56,239	64,000
,, Other Countries	5,703	4,627	26,789	30,432	65,523	58,143	369,586	399,200
Total	10,033	8,560	50,581	56,544	114,821	101,760	654,682	689,606
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	363	361	2,462	2,319	14,912	14,705	95,117	87,082
,, Enamelled	60	60	363	400	6,591	5,684	35,888	35,635
CASTINGS, in the rough—								
Iron	88	282	585	749	3,430	5,521	22,076	24,335
Steel	67	97	420	324	2,082	4,962	18,919	15,852

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG

IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
19, ST. VINCENT PLACE, GLASGOW.
ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

WANTED, a thoroughly capable FOUNDRY FOREMAN for Australia; applicants must have experience in production of miscellaneous work of the highest quality and possess sound knowledge of metal mixtures; the position offers splendid opportunities and future to a suitable man.—Apply, in confidence, stating age, experience, etc., to Box 772, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN required for Steel Foundry, capable of producing 100 tons of Light and Medium Castings per week; must be thoroughly acquainted with Machine Moulding practice; good organiser and strict disciplinarian; one used to Green Sand and Dry Sand Moulding and capable of fixing piecework prices; unless thoroughly experienced in all these branches applications will not be considered.—Reply, in confidence, stating age, experience and salary expected, to Box 766, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TENDERS.

CITY OF SHEFFIELD.

The Lighting Sub-Committee of the City Council is prepared to receive TENDERS for the supply of LAMP PILLARS for the Lighting Department for the twelve months ending 30th September, 1929.

Particulars and Form of Tender, together with "Conditions of Contract," etc., may be obtained on and after Saturday, 28th July, 1928, on application to the Lighting Engineer, 42, Corporation Street, Sheffield.

Tenders to be enclosed in the official envelope provided, endorsed "TENDER FOR LAMP PILLARS," and delivered not later than Wednesday, 8th August, 1928.

The Committee do not bind themselves to accept any TENDER.

Any person or firm sending in a Tender will be required to add a schedule to such Tender stating the names of the various classes of labour which he or they intend to employ, together with the places where such labour will be employed, and the rates of wages, hours of labour and the conditions of employment to be paid and observed in respect of each class of labour, all of which as shown in such schedule shall comply with the City Council's form of clauses respecting wages, hours, and conditions of labour, and prohibition against assigning or sub-letting, a copy of which in the "Conditions of Contract" will be furnished with the Form of Tender.

J. F. COLQUHOUN,
Lighting Engineer.

Public Lighting Engineer's Office,
42, Corporation Street, Sheffield.
23rd July, 1928.

MACHINERY.

MUST BE MOVED. PRACTICALLY NEW. BARGAINS.

By PNEULEC COMPANY.

ELECTRICALLY-OPERATED JAR-RAM MOULDING MACHINE, with MOTOR.

36 Pairs of Special MOULDING BOXES, for 12-ton latest specification Standard Split Axle Boxes.

36 Core Plates.

Cast-iron Pattern Plates with Mahogany Patterns and Core Boxes.

No. 4 Gas-fired Core Stove, 6 ft. x 9 ft. x 3 ft.; two compartments with thermometers.

FRANK JONES,
CAERAU CRESCENT, NEWPORT, MON.

SAND MIXERS.—Now and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

FOR SALE. Second-hand Moulding Machine for all classes of work, hand and power.—Apply Box 768, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

15-IN. FAN FOR SALE; 5-in. outlet; new; cheap.—Apply 43, Nashville Terrace, Salisbury Road, Keighley, Yorks.

New Cylindrical Grinding Machine; grinding capacity 4 ft. 1 in. long, 11¾ in. dia

Nearly New LANDIS Plain Cylindrical Grinding Machine, 12 in. x 42 in.

DIAMOND Surface Grinding Machine, with Magnetic Chuck 2 ft. 8 in. x 10 in.

Vertical Rotary Surface and Ring Grinder, with 12 in. dia. magnetic chuck; wheel, 8¾ in. dia.

3 ft. gauge, 4-wheel, 7 in. LOCOMOTIVE (Kerr Stuart), 0—4—2 type; steel firebox; 160 lbs. W.P.

2 ft. 6 in. gauge, 4-wheel, 7 in. LOCOMOTIVE (Bagnall); steel firebox; 150 lbs. W.P.

One good second-hand WATER-TUBE BOILER, by Babcock & Wilcox, Ltd.; steam drum, 22 ft. long overall x 3 ft. 6 in. diam.; reinsurable at a working steam pressure of 180 lbs. per square inch.

Two LANCASHIRE BOILERS, 30 ft. x 8 ft.; reinsure 110 lbs. pressure.

18,000 ft. of NEW 2 in. diam. Screwed and Socketed Piping, in lengths of about 18/21 ft. to British Standard Specifications and tested to 270 lbs. hydraulic pressure.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD LTD.,
ALBION WORKS, SHEFFIELD.

MACHINERY.—*Continued.*

MITCHELLS.

TWO VERY FINE, ALMOST EQUAL NEW, SENTINEL AIR COMPRESSORS,
500 cubic ft.
100-lb. pressure.
Also similar Compressor, 300 cubic ft.

THOMAS MITCHELL & SONS, LTD.,
BOLTON.
'Phone 302 (3 lines). 'Grams: "Realize."

PATENTS AND TRADE MARKS.

INFORMATION HANDBOOKS, Advice, and Cons. free; King's Patent Agency, Ltd.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146A, Queen Victoria Street, E.C.4. 40 years' refs. 'Phone: 0682 Central.

PATENT RIGHTS required for U.S.A. and Canada of any good patented article applicable to any branch of Engineering; advertiser, now in London, will be willing to negotiate for the exclusive rights for U.S.A. and/or Canada.—Box 770, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

GANISTER, best quality, for Cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

W.O. "PEERLESS" SPECIALITIES.—Fluxes for Brass, Gunmetal and Aluminium; Metallic Cement; Parting Powder; Liquid Core Sand Binder; all best and cheapest.

WILLIAM OLSEN, LIMITED,
COGAN STREET, HULL.

CHARCOAL.—Best Hardwood, Lumps and Chips, quoted for carriage paid terms.

WILLIAM OLSEN, LIMITED,
COGAN STREET, HULL.

'Phone: 287 SLOUGH.

CHEAP CRANE LADLES

1 Ton latest type NEW	£18
3 Ton EVANS	£28
5 Ton EVANS	£36
8 Ton	£40
10 Ton	£42
15 Ton STEVENSON	£65

ALL HAVE WORM AND BEVEL GEARING

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH.

	⅜ in.	½ in.	¾ in.	1 in.	1¼ in.	1½ in.	
Double Twisted STRAW ROPE	**7/6**	**7/8**	**9/2**	**11/4**	**14/9**	**16/9**	per 1,000 yards.
WOOD FIBRE ROPE - - -	**8/-**	**9/-**	**12/-**	**14/-**	**20/-**	—	do.

SUBJECT TO A SPECIAL DISCOUNT, FULL DIAMETER AND MEASURE GUARANTEED.

FREE DELIVERY ANYWHERE IN 10,000 LOTS.

Wire Brushes, Annealed Steel Wire, Core Gum, Molasses, Chaplets, Sprigs, Iron Cement, Plumbago, &c. ALL FOUNDRY REQUISITES.

Terra Flake **H. BIRKETT & SONS, Craven Street, Hull.** TELEGRAMS: BIRKETT, CRAVEN ST.